Douglas

VETERINARY MEDICINES

THEIR ACTIONS AND USES.

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DAVID DOUGLAS.

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THEIR ACTIONS AND USES

BY

FINLAY DUN

FORMERLY LECTURER ON MATERIA MEDICA AND DIETETICS AT THE EDINBURGH VETERINARY COLLEGE, AND EXAMINER IN CHEMISTRY IN THE ROYAL COLLEGE OF VETERINARY SURGEONS.

Seventh Edition, Revised and Enlarged

EDINBURGH
DAVID DOUGLAS
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PREFACE TO THE SEVENTH EDITION.

THE First Edition of *Veterinary Medicines* was published in 1854, when I was Lecturer on Materia Medica and Dietetics at the Edinburgh Veterinary College. The work continues a text-book at the British Veterinary Colleges, is used by Veterinarians and Agriculturists, and meets with increasing demand in the United States of America and in the Colonies.

The great progress made in Pharmacology since the publication of the Sixth Edition in 1882 has necessitated the rewriting of the book. A great deal of information has been derived from Dr Lauder Brunton's admirable work on *Pharmacology, Therapeutics, and Materia Medica.* The late Professor Robertson's *Equine Medicines,* and Professor Williams' volumes on the *Principles and Practice of Veterinary Medicine and Surgery* have been consulted as to the uses of medicines for the cure of disease. Mr J. H. Steele's treatise on *The Diseases of the Ox,* and various works on diseases of the dog and pig have been referred to. Professor Hertwig's *Praktische Arzneimittellehre für Thieraerzte,* and Professor Moiroud's *Traité Elémentaire de Matière Médicale et de Pharmacologie Vetérinaire,* have furnished details concerning the actions of several drugs.

As in previous editions, the general actions and uses of Veterinary Medicines, and the more important principles and practice of Pharmacy are treated of in the Introduction. This preliminary section has been arranged on the plan

adopted by Dr Lauder Brunton in his work above referred to, and medicines have been grouped according to their action on the several structures and organs of the body. For many valuable suggestions, and for his revision of this Introduction, as it passed through the press, I am greatly indebted to Professor J. M'Fadyean of the Royal (Dick's) Veterinary College.

The several drugs, discussed in alphabetical order, according to their English names, occupy the bulk of the volume. In this edition, under each individual medicine, the matter relating to the preparation and properties has been condensed; while the description of the actions on the several domesticated animals and the curative uses have received fuller and more systematic consideration. A careful revision has also been made of the doses and medicinal forms.

I have to thank Professor Fred. Smith and Mr Charles Rutherford, A.D.V., Aldershot, for their interesting notes of unpublished experiments on alkaloids, printed as an Appendix.

The Index of Diseases and Remedies, which in former editions was a mere list of drugs usually prescribed in particular disorders, has been considerably enlarged, and an endeavour has been made to indicate the conditions which dictate the use of remedies, and the manner in which they cure disease. Mr John A. W. Dollar, London, has greatly obliged me by revising this Index.

FINLAY DUN.

GORGIE HOUSE, EDINBURGH,
September 1889.

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VETERINARY MEDICINES:

THEIR ACTIONS AND USES.

INTRODUCTION.

VETERINARY MATERIA MEDICA, in the extended sense of the term, treats of every agent, material or immaterial, which is used for the cure of disease or injury, or for the preservation of health, among the domesticated animals. The full consideration of so large and diversified a subject would, however, fill several volumes, and the present work is restricted to the description of medicines or drugs, their natural history characters, their pharmaceutical preparations, and their actions and uses among the domesticated animals.

Medicines, although derived from various sources throughout the animal, vegetable, and mineral kingdoms, possess many actions in common, and are prepared for use by similar pharmaceutical processes. Some general observations will, therefore, advantageously occupy two preliminary sections, the first devoted to Pharmacology—which treats of the actions of medicines—and to Therapeutics, or their uses in disease; and the second to Pharmacy, which deals with the preparation and dispensing of medicines. The description of the medicines themselves occupies the body of the volume.

SECTION I.

THE ACTIONS AND USES OF MEDICINES.

THE treatment of disease has hitherto been less systematic and has progressed more slowly than the departments of medicine that relate to the symptoms of disease, and the morbid processes that underlie them. It has been more empiric than scientific. The actions of medicines have only recently been fully and philosophically studied. During the last thirty years more knowledge has, however, been obtained regarding the effects of medicines, and more skill and care have been employed in their use.

This progress in curative medicine has largely resulted from recent advances in our knowledge of the vital textures and their functions in health and disease, mainly obtained by systematic experiment and trained observation. Modern **physiology** has secured fuller and more accurate knowledge, especially regarding cell-development and nutrition, the actions of ferments or enzymes in many important vital phenomena, and the functions of the nervous system. **Chemistry** has helped to explain various complex living processes, and has contributed numerous remedial agents. The study of the **life history of microbes** has greatly extended the knowledge alike of the causes, prevention, and treatment of disease. **Pathology** has made clearer the exact nature and localisation of disease, and has thus given valuable indications for treatment. Clinical thermometers, auscultation, and other refined means of **diagnosis** inform the practitioner of the site, nature, extent, and tendency of morbid conditions. Practitioners, both of human and veterinary medicine, are thus more competent than heretofore to arrest certain disorders, to guide others in their most favourable course, and successfully to choose and skilfully to handle the curative weapons.

Systematic careful **experiments and observations** on the lower animals and on man, have demonstrated the action of many medicines, and have indicated their rational use in the cure of disease. Magendie's experiments with the Java upas antiar and

nux vomica have demonstrated that these strychnine-containing plants violently stimulate the spinal cord, producing tetanic convulsions. In virtue of this stimulation of the cord and its reflex functions, carefully regulated doses have been utilised for restoring disturbed co-ordination of the gastro-intestinal functions, and for relieving some forms of paralysis. Experiments on animals have demonstrated the action of digitalis as a cardiac stimulant, and hence have led to its use in strengthening and steadying the weak and over-taxed heart. Experiments with ergot of rye, and its active constituent, ergotine, proving their power of contracting arterioles and capillaries, have suggested their employment for the arrest of hæmorrhage from internal organs. Belladonna, and its active principle, atropine, diminish sensibility of the ends of the vagi and sensory nerves, and hence results their value in quieting cardiac irritability, diminishing excessive bronchial secretion, and relieving certain sorts of pain. The precise action of medicines once recognised, their practical use is rendered safer and more effective.

Recent investigstions have demonstrated that a number of diseases, such as the several forms of anthrax, glanders and farcy, hydrophobia, and influenza, depend upon **germs** or **microbes,** which, in susceptible subjects, rapidly multiply, and interfere profoundly with vital functions. The researches of Pasteur and Koch have shown that, by a process of **inoculation,** acting in a manner similar to that by which the vaccine lymph protects human patients from smallpox, protection may be afforded against the attacks of the anthrax disorders, hydrophobia, and contagious pleuro-pneumonia. The protective vaccine for anthrax is prepared by prolonged incubation of the natural virus at temperatures varying with the period of exposure. This attenuated virus, introduced into the bodies of susceptible subjects, produces only transitory disturbance; but the inoculated subject, in the majority of cases, is proof against the particular anthrax with the poison of which it has been vaccinated. In various localities throughout France and Germany, subject to splenic fever and quarter-ill, numbers of cattle and sheep are, by this means, effectually protected from these fatal diseases. The late Professor Robertson's experiments on inoculation as a preventive of quarter-ill, undertaken in various

English herds during 1886-87, did not obtain the uniformly favourable results reported by continental observers, but, in the main, corroborated their teaching that, with natural or carefully prepared virus and proper precautions, the majority of animals may be protected from anthrax diseases. Dr Willems, Mr Richard Rutherford, Edinburgh, and other veterinarians, have demonstrated that cattle, properly inoculated with pleuropneumonia virus, for a considerable period are not susceptible to a second inoculation, and do not take the disease when exposed to its contagion.

Further advances are destined to be made in the treatment of other classes of disease. **Antiseptics** may yet be discovered capable of checking the multiplication of septic germs in the blood and tissues, as they now do in a wound, or external to the body. Medicines may be found having power to increase, control or diminish the **formation of the ferments** which preside over nutrition, and which become sources of disorder when in undue or inadequate amount, or of faulty quality. The special **functions of** the several **nerve centres** in the brain, spinal cord, and elsewhere are becoming better understood; the manner in which they are acted upon by medicines is also being carefully studied; and such investigations will certainly contribute to the more effectual treatment of many diseases.

CLASSIFICATIONS OF MEDICINES.

Medicines are drawn from the three great natural kingdoms, and are characterised by various physical, chemical, and botanical properties; but these properties do not afford accurate or definite indications of their action on living bodies, and hence are not of much value for the practical classifications of medicines.

The **atomic weights of inorganic elements** have been used as a basis for classifying them and their compounds. The salts of the heavy metals are generally active poisons, but classifications based on atomic weight are of little or no value in determining on what organs, or in what way inorganic elements and their compounds act as medicines. Neither similar chemical constitution, nor similar chemical reactions, necessarily confer similar physiological actions. The same base, united with different

acids, produces salts which exhibit entirely different actions, as illustrated in the several compounds of sodium and potassium. Equally diverse physiological effects are produced by compounds resulting from conjoining the same acid with different bases. Two irritant corrosive substances, such as caustic soda and sulphuric acid, entering into chemical combination, produce a neutral, comparatively mild saline. Organic, like inorganic, bases are notably modified by the acid radicles with which they unite. Thus amyl-hydride is an anæsthetic; when oxygen is added, as in amyl-alcohol, or amyl-acetate, the anæsthesia is modified by spasm; amyl-iodide notably increases secretion, while amyl-nitrite lessens arterial pressure. It is hence evident that the action of a compound medicine cannot be inferred from a knowledge of the action of the substances that combine to form it. On the contrary, a compound substance exerts special actions of its own, these depending on the proportion of its components, and upon its own physical qualities.

Very important investigations in recent years have been made by Professors Crum-Brown, Fraser, and Schroff, in artificially **modifying** the **chemical constitution, and** thus changing the **physiological actions** of drugs. When strychnine, brucine, and thebaine, which act upon the spinal cord as powerful convulsants, have a molecule of methyl added, they act upon the ends of motor nerves, and become not convulsants, but paralysers. Indeed methyl, when combined with other alkaloids, as quinine, morphine, and codeine, renders these also powerful paralysers of motor nerves.

The study of the **natural orders of plants** affords some general information as to their physiological actions. Thus the Ranunculaceæ furnish many acrid irritants, such as aconite, podophyllin, and stavesacre. The Solanaceæ yield narcotics, such as tobacco and dulcamara, while the sub-order, Atropaceæ, are paralysers of involuntary muscles. The seeds of many Umbelliferæ yield carminative volatile oils. These general botanical characters do not however afford sufficient data for the accurate classification of drugs. Edible as well as poisonous plants occur in many natural orders. Plants of different orders and genera sometimes closely resemble each other, while plants of the same species may have very different properties. Thus one

species of strychnos yields strychnine, which causes convulsions of the spinal cord, while another yields curare, which fatally paralyses motor nerves. But even the same drug sometimes yields antagonistic active principles. Opium yields the soothing anodyne morphine, the convulsant thebaine, and the emetic apamorphine. Calabar bean yields physostygmine, which paralyses the spinal cord, and calabarine, which stimulates it to convulsion. Jaborandi yields pilocarpine, which stimulates the ends of the secreting nerves, and jaborine, which paralyses them.

The **grouping of medicines** according to their **actions** has not hitherto been of much more practical value than their chemical or botanical classifications. The precise actions of many medicines are only now becoming definitely known. Many, moreover, have a variety of actions, and hence have to be included in several groups. Alcohol, for example, is stimulant, irritant, narcotic, sedative, and anæsthetic, as well as refrigerant, tonic, and antiseptic. Opium is narcotic, anodyne, and soporific; but it also stimulates certain patients, and tetanises others.

Disregarding the classifications hitherto adopted, students and practitioners will find it advantageous to study the actions of medicines upon the chief organs and functions of the body. Adopting this method, Dr Lauder Brunton devotes a large section of his admirable work on Pharmacology, Therapeutics, and Materia Medica to an explanation of the actions of medicines on protoplasm, muscle, nerve centres, respiration, circulation, secretion, &c.; and following the same plan this introductory section will be sub-divided as follows:

Actions of Medicines.

Local and general actions:

Elective affinity between drugs and particular tissues or cells:

Effects on different classes of patients:

Modifying influences of Climate and Temperature:

Habit, Idiosyncrasy, Disease, and Surroundings.

Curative Systems: Allopathy, Homœopathy.

Medicines acting on Protoplasm, Blood, and Low Organisms.

Antiseptics: Disinfectants: Deodorisers: Antiperiodics.

Medicines acting on Muscles.
Muscular Poisons: Muscular Stimulants.

Medicines acting on the Nervous System.
On the Brain. Cerebral Stimulants: Exhilerants.
Cerebral Depressants: Soporifics: Narcotics: Anodynes: Antispasmodics: Anæsthetics.
On the Spinal Cord. Spinal Stimulants and Depressants.
On Motor Nerves. Stimulants: Paralysers.
On Sensory Nerves. Stimulants: Local Sedatives: Local Anæsthetics.

Medicines acting on the Eye and other Special Senses.
Mydriatics dilate the Pupil.
Myotics contract the Pupil.

Medicines acting on the Respiratory Organs.
Errhines or Sternutatories: Respiratory Sedatives: Expectorants.

Medicines acting on the Circulatory Organs.

Cardiac Stimulants:	Vascular Stimulants:
„ Tonics:	„ Tonics:
„ Sedatives:	„ Sedatives.

Remedies acting on the Surface of the Body.
Rubefacients: Vesicants: Pustulants: Caustics:
Setons: The Actual Cautery:
Astringents: Styptics:
Demulcents: Emollients.

Medicines acting on the Digestive System.
On the Salivary Glands and Fauces. Sialagogues: Antisialics: Refrigerants.
On the Stomach. Gastric Tonics: Stomachics: Bitters: Antacids: Emetics: Anti-emetics: Gastric Sedatives.
On the Intestines. Purgatives: Carminatives: Intestinal Astringents.
On the Liver. Hepatic Stimulants: Cholagogues: Hepatic Depressants:
Drugs acting on the Pancreas and Spleen.
On Worms. Anthelmintics: Vermicides: Vermifuges.

Remedies acting on Tissue change.
Restoratives: Tonics: Hæmatinics: Alteratives:
Antipyretics: Febrifuges: Blood-letting.

Medicines acting on the Kidneys and Bladder.
Diuretics: Lithontriptics:
Urinary Sedatives: Urinary Astringents.

Medicines acting on the Organs of Generation.
Aphrodisiacs: Anaphrodisiacs:
Ecbolics:
Agents acting on Mammary Glands.

Medicines acting on the Skin.
Diaphoretics: Sudorifics.

Poisons and Antidotes.

Mode of Administration.
Doses: Manner of exhibition.

THE ACTIONS OF MEDICINES.

LOCAL AND GENERAL ACTIONS—ELECTIVE AFFINITY BETWEEN DRUGS AND PARTICULAR TISSUES OR CELLS—EFFECTS ON DIFFERENT CLASSES OF PATIENTS—MODIFYING INFLUENCES OF CLIMATE AND TEMPERATURE, HABIT, IDIOSYNCRASY, DISEASE, AND SURROUNDINGS.

Every medicine is possessed of certain **effects** or **actions** on **living animals,** as distinctive as its colour, taste, or chemical properties. Such actions, when exerted alike in health and disease, are termed **physiological actions**; when exerted in the cure of disease, they are termed **therapeutic** or **curative actions.** These actions cannot, however, be regarded as two-fold or distinct. The physiological action determines, and is merged in, the curative result. A horse eats some indigestible food, and consequently suffers from spasm of the bowels: a purgative exerts its physiological effects of increasing intestinal secretions and peristaltic movements; the irritant is thus swept away, curing the spasm and pain. A dose of physic, prescribed for a horse with itching or swollen legs, produces the physiological effect of emptying the bowels, and clears irritant matters out of the body, with the curative results of relieving or removing the itching and swelling of the limbs.

Some medicines are chiefly **local** and **direct** in their action.

A strong acid applied to the skin irritates and, it may be, destroys it. A hot fomentation or poultice in contact with a painful irritated surface soothes and relieves local congestion and pain. But in the higher animals, all parts of the body are so intimately connected, that impressions made on one spot are by reflex action speedily conveyed to other parts. Hence the primary effects of local irritants, or local soothers are frequently followed by **secondary** or **remote** effects. In sore throat, the application of a cantharides blister directly irritates and inflames the external skin, but reflexly it relieves congestion, inflammation, and pain of the respiratory membrane. Still further and more remote effects sometimes follow. In horses, a large cantharides blister, owing to absorption of the irritant principles of the fly occasionally produces febrile symptoms, and moreover stimulates the urinary passages by which the irritant is excreted.

The **general effects** of most medicines are produced only when they enter the body. They may be injected directly into either veins or arteries, a method rarely adopted however, excepting for experiment, or in extreme cases. Injection is occasionally made into a gland or muscle, and frequently into the subcutaneous cellular tissue, whence the unchanged medicine is promptly absorbed, by the blood-vessels or lymphatics. When inhaled through the pulmonary mucous membrane, volatile agents are quickly carried into the blood. Soluble medicines are absorbed through the broken, and in small amount even through the unbroken, skin. But the most frequent and generally the most convenient method is by the mouth, whence, speedily reaching the stomach or anterior part of the small intestine, medicines enter the circulation From the lower portions of the alimentary canal absorption also takes place, although not so rapidly.

Medicines administered as they should be, in a tolerably concentrated, and soluble form, do not require to be reduced by mastication, or acted upon by the ferment-containing secretions of the digestive canal. But the digestion of mashes and many restorative foods is helped by the alkaline saliva, the ptyalin of which cracks starch granules and renders them soluble. The acid pepsin-containing gastric juice dissolves albuminoids, as well as iron, mercurial, and other salts. The alkaline bile emul-

sionises fats and resins. The pancreatic fluid furthers digestion of starch, albumin, and fats. Specially refractory substances are more thoroughly reduced by the intestinal juices, which convert cane into grape sugar. The alkaline blood, flowing rapidly and with a specific gravity of 1050, which is higher than that of the other animal fluids, presents conditions eminently favourable for the absorption or endosmose of medicines. Different substances act differently upon the moist digestive membrane, and in various ways make their entrance into the circulation. Through the capillary vessels and absorbents which ramify on the surface of the stomach and small intestines, medicines, as they are disolved, are carried by the mesenteric and portal vessels into the liver, which sometimes retains and diminishes their action.

The more rapidly a medicine enters the circulation, as when it is introduced into a blood vessel, is injected subcutaneously, or is placed in contact with an actively secreting serous surface, **the more immediate** and **powerful** are its effects. The short time taken for absorption, distribution throughout the body, and production of special actions, is illustrated in the rapidly fatal effects of such poisons as prussic acid. Professor Hering, of the Veterinary College, Stuttgart, found that yellow prussiate of potash injected into one of the jugular veins of a horse appeared in the other in twenty-five seconds, and was exhaled from the mucous and serous membranes in a few minutes; and also that barium chloride injected into the jugular vein of a dog reached the carotid artery in seven seconds. Dr A. Waller, of Geneva, found that when the foot of an albino rat was immersed in a solution of one per cent. of atropine in chloroform, even for a few seconds, absorption occurred, and the pupil of the eye became dilated in from two to five minutes. Dr Blake observed that barium chloride and nitrate traversed the whole circulation of a dog in nine seconds, and that of a horse in twenty seconds.

Between certain organs, tissues, or groups of cells, and certain medicines, there is a **special elective affinity.** From the common stream of blood each tissue takes up its appropriate nutrient materials, and, in like manner, it appears to select its own medicines. **The characteristic effects are not developed until medicines come into actual contact with the special organs,** or, it may be, the particular cells, on which alone they operate. Curare

does not exert its paralysing power until it reaches the ends of the motor nerves. Magendie found that strychnine does not excite its notable tetanic convulsions until it is in contact with the spinal cord. Indeed, when a frog or other small animal, immediately after receiving a full dose of strychnine, has the spinal cord removed or broken down by a piece of whalebone, tetanic symptoms do not occur.

On the particular part on which they act, such as the nerve-centres or nerve-ends, that control blood-vessels or glandular secretions, some **medicines exert stimulant,** others **depressant** or **paralysing effects.** These effects, as already indicated in the case of drugs acting locally, frequently produce reflexly indirect or remote effects. The same medicine sometimes acts differently when given in **different doses.** Thus, alcohol and ether in small doses are stimulants, but in large doses are depressants. Within the living body most **medicines** not only **effect changes,** but themselves coincidently **undergo changes,** notably of **oxidation** or **deoxidation.** Thus, many salts of tartaric, acetic, and other organic acids, are converted into carbonates. Morphine has its chemical constitution altered, and its soothing anodyne actions superseded by nauseating and irritant effects. The period during which medicines remain within the body notably affects their activity. Some drugs, as lead, mercury, silver, and digitalis, are apt to be retained for a considerable period, and hence have more or less continuous or **cumulative effect.** Unusual activity of such excreting channels as the bowels or kidneys hurries most medicines out of the body, and hence diminishes their action.

In a variable but usually short period, medicines, generally in a modified form, are **got rid of by** one or more of the **excretory channels**—the bowels, kidneys, skin, or pulmonary mucous membrane. Digitalis, for example, after exerting its action mainly on the heart and arterioles, is removed by the kidneys. Alcohol and its analogues are got rid of by the skin and kidneys, and also pass away through the respiratory mucous membrane. In the act of being excreted some medicines increase the activity of the excretory organ. Thus, aloes and full doses of oils and neutral salts, after producing local irritant effects on the bowels, are in part absorbed into the blood, and thence are

returned into the bowels, causing further purgation. Nitre, and small doses of salines and ethers, chiefly removed through the kidneys, produce diuresis.

The several species of veterinary patients are differently affected by many medicines. These differences, however, are in degree rather than in kind, and depend upon differences in organisation and function. On the circulatory, respiratory, and urinary systems, which nearly resemble each other in man and the domestic animals, medicines act tolerably uniformly. Thus, aconite, digitalis, and nitre produce very similar effects in men, horses, dogs, and cattle. Greater diversity, however, occurs in regard to medicines acting on the nervous, digestive, and cutaneous systems, which differ considerably in the several species of animals. **The more highly any organ** or system of organs **is developed,** the more susceptible does it become to the action of medicines, and, it may be added, to diseases also. This general law explains why the highly developed human brain is specially susceptible to the effects of such cerebral medicines as opium and chloral, and why frogs, whose spinal system is developed at the expense of their brain, are so susceptible to strychnine, which acts specially on the cord. The human cerebrum, the seat of intelligence, is more than seven times the weight of the mesencephalon and cerebellum which regulate motor energy. In the domestic animals the cerebrum is only five times the weight of the posterior parts of the brain, whilst the cord is relatively larger than in man. These differences of development explain how such medicines as opium, chloroform, and chloral cause in man blunted intellectual function and deep stupor, while in the lower animals, with less marked depression of brain function, they conjoin more marked deranged motor function and convulsions.

The Horse has a small stomach, and capacious, highly-vascular intestines, adapted for absorption of nutriment from bulky vegetable food. Nearly two-thirds of the water in the ingesta pass off by the bowels, while in man only five per cent. is got rid of by this channel, and the amount is still less in dogs and cats. Vegetable purgatives, notably aloes, appear more suitable than mineral purgatives and act only slightly on the stomach, and chiefly on the small and large intestines. Except in very rare

diseased states, and under the influence of large doses of aconite, attempts at vomition are never excited in horses. Tartar emetic, of which a few grains cause immediate emesis in dogs, has scarcely any physiological effect either on horses or cattle. According to some authorities, this insusceptibility of the horse towards emetics is due to an inaptitude of the vagus nerve to receive and convey the special irritation, but more probably it is ascribed to imperfect development of the vomiting centre. Actual vomition in horses is hindered by the small stomach not being readily compressed between the diaphragm and abdominal muscles; and by the stout band of muscular fibres which surrounds its œsophageal opening. Most substances which act as emetics for men and dogs, are supposed to produce sedative effects when given to horses in sufficient doses; but the many sedatives available in human and canine practice operate uncertainly and imperfectly in horses, for which aconite is the chief reliable sedative medicine. The kidneys of horses are readily acted on; in ordinary circumstances they remove about one-seventh of the fluid ingesta, while the same organs in man drain away 54 per cent., and in dogs nearly 50 per cent. of the fluid discharges. Sudorifics are less prompt than in man, and are apt to act on the kidneys, unless the animal be well clothed.

In Cattle the peculiarities of the action of medicines are chiefly referable to the construction of their alimentary canal, and to their phlegmatic temperament. The stomach of these ruminants is quadrisected, is extensively lined with cuticular mucous membrane, and, as regards its first three divisions, is less vascular and in function more mechanical than the corresponding portions of the alimentary canal in men, dogs, or horses. The first and third compartments always contain food, often in large quantity. These facts explain why cattle require large doses of all medicines, why considerable quantities of irritant and corrosive poisons can be given them with comparative impunity, and why purgatives, unless in large doses and in solution, are so tardy and uncertain in their effects. The kidneys and skin of cattle are less easily acted on than the corresponding organs in horses; and their dull phlegmatic disposition resists the action both of stimulants and tonics. It is a very prevalent notion

that medicines, when poured very slowly down a cow's throat, pass, like the ruminated food, direct to the fourth stomach. From observations made at the slaughter-houses on both cattle and sheep, I find, however, that neither animal can be induced to exert this voluntary effort in behalf of our medicines, which in all cases, no matter how slowly they are administered, fall partly into the first and second stomachs, whence they shortly pass onwards through the third and fourth stomachs, especially if given, as they always ought to be, with a considerable quantity of fluid.

Sheep closely resemble cattle in the way in which they are affected by most medicines; they usually require about one-fourth of the dose suitable for cattle; and are best drenched by being backed into a corner, the head being steadied between the operator's knees, while the medicine is cautiously poured over.

On Dogs medicines generally operate much in the same way as on man; but to this rule there are some remarkable exceptions. Dogs, for instance, take six or eight times the dose of aloes usually given to the human subject, but are seriously injured by half as much calomel or oil of turpentine as is prescribed for a man. The opinion generally held, that medicines may be given to dogs in the same doses as to men, cannot therefore be safely entertained without a good many reservations. In dogs the alimentary canal is short and straight; and purgatives consequently act with greater rapidity than in other veterinary patients. Another peculiarity is the facility with which they can be made to vomit. Indeed, vomition in dogs is often naturally produced by their eating various grasses, by their swallowing nauseous or unpalatable matters, or by their overloading the stomach. To prevent dogs vomiting their medicine, it is well to keep the head raised for an hour after its administration; and this may be easily effected by attaching a chain or cord to the collar, and fixing it to any object at the requisite elevation. The kidneys are excited with more difficulty than in horses or cattle.

On Pigs the effects of medicines are similar to their action on men and dogs.

Dr Lauder Brunton points out several curious differences in the action of drugs on several of the lower animals. Morphine convulses frogs, but, even in large doses, has no effect on pigeons,

except in reducing their temperature. Belladonna quickens cardiac action in man, dogs, and horses, by paralysing the vagus, which controls or restrains heart action. But in rabbits the vagus has hardly any appreciable effect in regulating the heart beats, and these animals, accordingly, take large doses without having the rapidity of the circulation increased. The rabbit's heart, not being controlled by the vagus, a marked difference also occurs in the action of amyl-nitrite on rabbits as compared with dogs. Such observations are not only most interesting in themselves, but greatly further the understanding of the actions of drugs.

Climate and Temperature modify considerably the actions of medicines. Narcotics are generally believed to act more powerfully in warm than in cold climates. This fact, as well as other differences in medicines observed in hot as compared with cold climates, may depend upon slight differences in animal temperature, and in the varying amount of excretion effected by the skin and kidneys.

Moderate warmth favours chemical reactions and protoplasmic movements—two conditions intimately connected with the actions of medicines. "Alexander von Humboldt first observed that warmth not only acted as a stimulant to the heart, increasing the power and rapidity of its contractions, but noticed that warmth increased the rapidity with which alcohol destroyed the irritability of a nerve, and potassium sulphide that of a muscle. . . . Many, if not all, muscular poisons act more quickly with increased temperature. . . . Rabbits poisoned with copper or potassium salts also die more quickly when placed in a warm chamber than when left at the ordinary temperature" (*Brunton*). On the other hand, however, narcotic poisoning by alcohol or chloral is retarded when the animals are in a warm atmosphere.

Habit.—The continued use of a medicine sometimes alters the degree of its action. Caustics and irritants, which exercise only topical action, exhibit, on their repeated application, gradually increasing activity. But many medicines, when continuously administered, have their ordinary power considerably diminished. Thus arsenic-eaters sometimes use with perfect impunity twelve or fifteen grains of arsenic daily—a quantity sufficient to poison three or four unhabituated persons. A like tolerance is observable amongst horses which have been accustomed to receive

arsenic. Opium, and most general stimulants, when administered for some time, gradually lose their effects. Virginian deer, from habit, are said to thrive on tobacco; some monkeys, feeding on strychnine-containing nuts, are stated to become insusceptible to strychnine *(Wood)*. This accommodation to the habitual use of a medicine sometimes depends on retarded absorption, or quickened excretion, and possibly, in the case of vegetable drugs, on the liver acquiring greater power for their arrest, excretion, or destruction.

Idiosyncrasies, probably the result of reversion to ancestral forms, which in the human subject render some poisons almost innocuous, and some simple medicines deadly poisons, are much less frequent and notable among the lower animals. Those of most frequent occurrence among veterinary patients are either an increased or a diminished susceptibility to the action of purgatives and diuretics. Most medicines act with greater certainty and effect upon well-bred animals, whether amongst horses or dogs, than upon coarsely-bred mongrels. The prescription even of a mustard blister or a colic draught demands consideration of the temperament and condition of the patient.

Diseases modify the actions of many medicines. The altered structure and functions of the diseased body modify the effects of most drugs, the increased temperature occurring in most febrile disorders is an important modifying factor. A congested or inflammatory condition of the alimentary canal, or even an overloaded stomach retards absorption, and the consequent activity of medicines given by the mouth. Acute fever, on account of increased arterial pressure, is also unfavourable to absorption. When excretion is hindered, medicines however, are usually retained longer in the system, and some accordingly act more powerfully. Conversely, when excretion is active, as in diuresis, diabetes, or diarrhœa, such medicines as opium, belladonna, and alcohol, being rapidly got rid of, do not manifest their full activity. Influenza, low fevers, and any considerable inflammation of mucous or cutaneous surfaces, withstand reducing remedies badly, and require for their successful treatment the early exhibition of restoratives, tonics, and stimulants. Even the comparatively slight and temporary requirements for the changing of the coat render horses in

spring and autumn notably less enduring and less able to stand lowering treatment. Blood-letting and full doses of sedative medicines induce less depression in acute inflammation than in health; large quantities of opium and chloral hydrate have comparatively slight effect in tetanus, hydrophobia, or enteritis; while excessive doses both of purgatives and stimulants, are tolerated in the apoplectic form of puerperal fever among cattle, and in other cases in which there is depression of nervous force.

The surroundings of the patient materially alter the action of remedies. Diseases, whether in horses, cattle, or dogs, occurring in large towns, and in filthy, overcrowded, and badly-ventilated premises, are notoriously liable to assume chronic, typhoid, and untoward forms, and are apt to defy even skilfully devised curative measures. Medicines can only act effectually when seconded by proper sanitary arrangements. Overheated, imperfectly-ventilated stables lower the vitality of their inmates, by retarding excretion, and favouring absorption of noxious exhalations. Such facts demand consideration alike in the treatment and prevention of disease. Frequently a horse with influenza, bronchitis, or pneumonia, is thrown back for days by being senselessly stripped and taken out of his box in cold weather. One meal of coarse indigestible food, even of moderate amount, sometimes retards recovery from gastric derangements, and indeed from most debilitating diseases. Constipation and torpidity of the bowels interfere with absorption and satisfactory operation of all medicines. Exposure to cold seriously injures patients which have received full aperient doses of salts or of turpentine, or which have been freely dressed with mercurial ointment. Foul air and disordered digestion prevent the healing even of simple wounds. On the other hand, gentle exercise encourages the action of most eliminatives; quiet favours the effects of soothing remedies; generous diet seconds powerfully the benefits of restoratives, tonics, and stimulants. Inflammatory disorders usually bear more prompt and actively depleting treatment in winter than in summer; in the country than in the town; in well-bred animals in good condition, rather than in coarser subjects which have been indifferently nourished.

CURATIVE SYSTEMS: ALLOPATHY, HOMŒOPATHY.

THE difficult question is frequently asked.—**How do medicines cure disease?** The complex composition and diverse functions of the bodies of the higher animals are liable to be altered and disturbed in many different ways, and such alteration, or deviation from the normal harmony of health, cannot be restored by any one curative system or formula. As already indicated, medicines have special actions on different organs or groups of cells, and affect them in very different ways, and hence would seem to produce their curative effects, not in one, but in many ways. The late Professor Headland taught that "the only general explanation we can give of the *modus operandi* of medicines in the cure of diseases, is to say that they operate by various **counteractions.**" Two such systems of counteraction have been propounded—(1.) the **antipathic,** whereby medicines were believed to overcome morbid conditions or symptoms by a superior, and antagonistic force; (2.) the **allopathic,** whereby effects are produced, which, although they may sometimes be unnatural, overcome the disease. But diseases, it has been affirmed, may not only be cured by counteractions, but by similars. Upon the old saying that "like cures like," **Homœopathy*** is based, and its votaries declare that diseases

* Homœopathy (ὅμοιος, *homoios*, like or similar; and πάθος, *pathos*), was propounded by the German physician, Hahnemann, in his *Organon der Rationellen Heilkunde*, published in 1810. This system teaches that the cure of a disease is effected by infinitesimal doses of such medicines as would induce, if given to a healthy subject in large quantity, symptoms similar to the disease. Cinchona is declared to cure such fevers as ague and intermittents, because it produces some such febrile symptoms when given to healthy individuals in considerable doses; aconite is regarded as the appropriate remedy for reducing inflammatory fevers, because in large doses it produces symptoms which are thought, by homœopathists, to resemble those of inflammation; while strychnine is selected as a remedy for paralysis, because in large doses it appears to produce paralytic symptoms. This doctrine, if sound, would stamp most disorders as hopelessly incurable; for it is only in a few exceptional cases that any similarity can be detected between the symptoms produced by large doses of the remedy and those of the disease for which it is given. No known medicines, for example, are capable of developing symptoms such as those of thick-wind, roaring, pleurisy, strangles, distemper, or hydrophobia, yet fifteen or twenty remedies are prescribed homœopathically for each of these diseases. Glanders, farcy, and consumption are treated by aurum, arsenicum, and bromine; but none of these medicines develop symptoms similar to the diseases for which they are

are to be treated by small doses of such medicines as in large doses produce symptoms similar to the disease to be cured. The pathological conditions which underlie and produce the symptoms, and which a rational cure generally aims if possible at removing, are ignored. The homœopathic dictum of *similia similibus curantur* does not bear investigation; at best it is only capable of narrow, and occasional acceptance. The symptoms of ague and intermittents are certainly similar to those produced by cinchona bark, which is the accepted cure for ague, and the illustration on which Hahnemann founded his system. But many diseases exhibit no symptoms accurately similar, as the homœopathists insist they should be, to those produced by the medicine prescribed for their cure. Numerous

used. Again, the disciples of Hahnemann treat diseases the most dissimilar in their nature and symptoms by the same remedy. Thus Mr Haycock, in his *Elements of Homœopathy*, employs arsenic as the appropriate remedy in mange, bronchitis, enteritis, diabetes, strangles, tetanus, rheumatism, ophthalmia, poll-evil, glanders, and thirty other diseases; whilst he prescribes aconite in thirty-two diseases, beginning with papular eruptions, including most affections of the respiratory and digestive organs, and ending with ophthalmia and glanders. An "accurate similarity" between the symptoms of the disease and those of the remedy is, however, regarded as essential to the success of the homœopathic treatment; but where is the similarity between the effects of arsenic and these forty diseases for which it is prescribed, or between those of aconite and the thirty-two diseases in which it is considered so efficacious? These and many other such instances cannot be established without straining similarities which, to ordinary eyes, are imperceptible, or at best but very remote.

Mr Dudgeon's translation of the *Organon of Medicine*, accepted by English homœopathists as their standard authority, states that "the symptoms of each individual case of disease must be the sole indication, the sole guide to direct us in the choice of a curative remedy" (p. 120). Now symptoms, although sometimes requiring special treatment, are but the visible signs and results of derangement and disease; whilst their removal, which is all that is aimed at in homœopathic treatment, does not always insure the removal of the conditions on which they depend. Thus rheumatism, pleurisy, enteritis, worms, and many other disorders, frequently remain unchecked after their symptoms have been relieved. Instead of thus vainly attempting the removal of symptoms, it were, therefore, more rational to remove at once the morbid condition —the source of the evil. No curative system directing its efforts, as homœopathy does, merely against the symptoms of disease, can ever rest upon a safe or scientific basis; for it is notorious that, under varying modifying influences, the same diseases sometimes induce very dissimilar symptoms, and would consequently, according to this system, require dissimilar treatment. On the other hand, diseases essentially different sometimes manifest similar symptoms. Thus stupor and vertigo result sometimes from an excessive and sometimes from a deficient quantity of blood sent to the brain; difficulty

drugs moreover cause symptoms wholly unlike those of the diseases, in the treatment of which homœopathists use them.

The homœopathic selection of so called appropriate remedies, on the presumption that "like cures like," is based upon a fallacy, while the minute finely triturated and subdivided doses are too attenuated to affect veterinary patients. The practice of homœopathy has, however, developed wholesome discussion, and some useful experiments on the actions of medicines, has helped to show the evils of heroic and indiscriminate drugging, has taught the advantage of simple prescriptions, exemplified the power of nature to cure, when not too much interfered with, and demonstrated the powerful influence of diet and regimen in the successful treatment of disease.

of breathing from too much as well as from too little blood circulating through the lungs; vomiting from irritation of the stomach, or from irritation of the vomiting centre; diarrhœa from crudities in the alimentary canal, or irritant matters in the blood. Now, in these cases, similar symptoms, although depending upon unlike morbid conditions, must, according to homœopathy, be combated by the same remedies; for, it is written, "Diseases are cured by such medicines as have the power of producing, in healthy individuals, symptoms similar to those which characterise the diseases themselves" (Haycock's *Elements*, p. 20). No provision, be it remarked, is here made for cases in which the same symptoms result from different or opposite conditions; and yet we not only find the same symptoms produced by very different diseases, but also by the most opposite remedies. Strychnine and prussic acid, for example, although totally dissimilar in their *modus operandi* and general action, both induce convulsions, and should therefore, according to the tenets of homœopathy, be equally suitable for the cure of the same convulsive diseases.

Not only are the principles on which homœopathy is said to be based untenable, but the details of the system are inconsistent and ridiculous. The homœopathic doses are so small, that they are often incapable of detection either by the microscope or by chemical analysis, and are sometimes so inconceivably minute, that the mind can form no idea of them. It is admitted, even by homœopathists, that millions of such doses may be swallowed by a healthy individual without inconvenience; but in disease, the body is stated to become so susceptible to their action, that much risk is incurred by their insufficient dilution! Medicines, such as charcoal, sand, and calcium carbonate, which, in doses of several drachms, have only a slight mechanical effect, when given in fractional parts of a grain are thought to produce very powerful effects, and cause many hundred symptoms. Charcoal, for example, is said, when given to human patients in very minute doses, to produce 930 distinct symptoms; oyster shell, 1090 symptoms; and the ink of the cuttle-fish, 1242 symptoms! The extraordinary powers supposed to be conferred on these and other medicines, even when given in doses of inconceivable minuteness, are chiefly ascribed to the magic influence of careful and continued triturations

ACTION OF MEDICINES ON PROTOPLASM, BLOOD, AND LOW ORGANISMS.

ANTISEPTICS—DISINFECTANTS—DEODORISERS—ANTIPERIODICS

The mode of life of the tissues of the higher animals, and the way in which these tissues are acted on by medicines, have in recent years been strikingly illustrated by examination of these phenomena as they occur in the simplest animal structures. The complex albuminoid material termed **protoplasm,** which is the ever-present constituent of living cells, is coagulated and precipitated by heat, and dissolved by alkalies. It is precipitated by small quantity, and dissolved by excess, of most mineral acids.

and often-repeated shakings, performed according to most precise directions. Some homœopathic authorities declare that there is little difference of activity between different dilutions of the same medicine; and it is said that, if the medicine be well selected, it matters little whether the tenth, hundredth, or thousandth of a grain be used (*Gunther* and *Haycock*). There is probably some truth in this observation, for, with most medicines, especially when administered to the lower animals, all the dilutions mentioned would be equally harmless. The admixture of different medicines with one another is said to neutralise the effect of all; but if this be the case, homœopathic drugs must always be without effect (which is very probable), for all medicines contain adulterations and impurities which, though small in amount, must, if homœopathic reasoning be consistent, acquire great potency by the triturations above mentioned.

But homœopathists assert that, in spite of the errors which their opponents discover in the system, it is nevertheless very successful in the cure of disease. In judging, however, of homœopathy as a system of practical medicine, it must be regarded as made up of two distinct parts:—1*st*, The original and peculiar part of the system, consisting in the use of medicines selected in accordance with a law embodied in the axiom *similia similibus curantur*, and administered in infinitesimal doses, usually varying from one grain to one-millionth of a grain, and carefully prepared according to certain precise directions; and 2*nd*, Attention to diet and regimen—the only effectual and rational part of homœopathy, the true source of all its boasted cures, and that department of medical treatment which has always been insisted upon by rational and successful practitioners, both of human and veterinary medicine. The value of medicines given homœopathically has never been satisfactorily shown, and never can be so until two series of cases, as nearly as possible alike, be treated—the one in the usual homœopathic fashion, the other with the same attention to diet and regimen, but without the globules. In comparative experiments, made at the Edinburgh Veterinary College, as to the treatment of pleuro-pneumonia and other diseases, it appeared that those cases treated by diet and regimen alone were as speedily and effectually cured as those treated with the globules in addition, so long as these globules were given only in homœopathic doses.

Organic alkaloids resemble acids in lowering the temperature at which heat coagulates albumin. Protoplasmic movements, as illustrated in the amœba, are retarded or arrested by cold. Heat, slight electric shocks, and common salt even in diluted solution first quicken them; but a temperature of 35° C., a stronger electric current, or prolonged exposure to a saline solution, tetanises them. Protoplasm has the power of absorbing and storing oxygen; and the chemical energy developed from this oxidation is capable of conversion into mechanical energy and movements. Protoplasm has also the power of carrying and transferring oxygen to other substances, and appears to contribute largely to the diffusion of oxygen, and interchange of gases, constantly occurring between the blood, the intercellular fluid, and the cells, and constituting what is termed internal respiration.

Leucocytes are affected in much the same way as amœbæ. Their movements are, besides, notably arrested by the cinchona alkaloids and beberine sulphate. Quinine injected into the circulation has also been found to diminish the migration of leucocytes from the blood-vessels.

The **red corpuscles** pass out of the vessels when an excess of sodium chloride is introduced into the blood, while still more rapid extravasation is produced by the rattlesnake poison. The size of the red corpuscles is increased by oxygen, hydrocyanic acid, quinine, and cold, and diminished by carbonic acid, morphine, and warmth.

The important blood constituent **hæmoglobin,** like protoplasm, has great capacity for taking up oxygen, thus becoming converted into oxyhæmoglobin, which holds, however, its added oxygen loosely, and parts with it readily, as it slowly circulates through capillary vessels. The hæmoglobin also combines with other substances as well as with oxygen—as with hydrocyanic acid and carbonic oxides, forming tolerably stable compounds, which, however, neither take up oxygen in the lungs, nor give it off in the tissues, and which hence become asphyxiated. Addition to the blood of such drugs as alcohol, chloroform, quinine, morphine, nicotine, and strychnine, likewise, in various degrees, diminish the amount of oxygen absorbed, and of carbonic acid given off by the blood. "Uric acid and snake-poison had

a contrary effect, increasing the absorption of oxygen and the evolution of carbonic acid. Curare appeared to lessen the absorption of oxygen, but increased the evolution of carbonic acid. Mercuric chloride lessened the carbonic acid, but increased the absorption of oxygen. Arsenious acid and tartar emetic diminished the absorption of oxygen; but arsenious acid appeared also to lessen the evolution of carbonic acid, while tartar emetic appeared to increase it" (*Dr Lauder Brunton*).

Infusoria have both their rhythmical and ciliary movements increased by heat, and diminished by cold. Weak saline solutions increase their movements; while strong saline solutions alter the amount of water they contain, and cause them first to shrivel, and subsequently to swell.

The growth and decay of plants and animals, their healthy nutrition, and many of their diseases, are determined by the operation of a numerous widely distributed class of bodies known as **ferments,** familiarly exemplified by the yeast which raises bread and converts the starch and sugar of barley into beer or spirit, the rennet which coagulates milk, the fungus which causes ringworm, and the bacillus which induces the deadly anthrax. Ferments are divisible into two classes:—

1. **Organic ferments** or **enzymes,** such as diastase, which causes germination in barley and other seeds, ptyalin from saliva, pepsin from the stomach, trypsin from the pancreas, with histozyne, a recently discovered ferment present in blood, and believed to be the chief agent in the reduction of albuminoids. They contain carbon, are hence organic, but are devoid of definite structure, and are not organised or living.

2. **Organised** or **formed ferments,** such as yeast, mycoderma vini, moulds, and bacteria, are living vegetable organisms belonging to the class of fungi.

In their great function of **reducing complex** carbon compounds **into simpler forms,** both classes of ferments require a moderate temperature: very low or very high temperatures interfere with their action. Their disintegrating effects are produced, it is believed, in one of two ways:—(1.) By abstraction of water, as in the conversion of starch into sugar, or the splitting up of glucosides—changes chiefly effected by enzymes, and analagous to the effects of heat in conjunction with diluted

mineral acids or alkalies. (2.) The breaking up of the fermentesible body is sometimes effected by transfer of oxygen from its hydrogen to its carbon, as in alcoholic and lactic fermentations, and in putrefactive processes—a mode of reduction usually effected by the organised ferments, and probably analagous to the action of spongy platinum, which readily absorbs oxygen, and gives it off again to oxidisable substances.

The organised ferments, which are the chief causes of putrefaction and of various diseases, have been simply and conveniently classified as—

1. **Yeasts,** consisting of ovoid cells, multiplying by budding, and represented by the torula cerevisiæ, mycoderma vini, and probably also including the aphthous patches of thrush found in the mouths of young animals.

2. **Moulds** occurring in filaments, which are agglomerated into masses of tufts, multiplying by budding and formation of spores, and exemplified by the common moulds which appear on moist objects, and by those which cause such skin diseases as favus and several varieties of tinea.

3. **Bacteria** or **Schizomycetes** are of several varieties, occurring as microscopic bodies of different sizes and shapes—ovoid micrococci producing erysipelas, gonorrhœa, and acute necrosis; rod or thread-like forms seen in the bacilli of hay, septicæmia, anthrax, and tuberculosis; and the twisted or spiral forms of the vibrio serpens, and of the spirochæta, the probable cause of relapsing fever in man. They increase by multiplication of their units, and by formation of spores; require for their existence water, organic matter, and salts; some, in addition, need oxygen, others thrive without it. They speedily exhaust the nutriment obtainable from the substance on which they grow, or form in it matters inimical to their life; but where one species thus perishes, others frequently spring up and flourish. Some of these bacteria are innocuous; others, notably the rod-shaped and filamentous species, when introduced into the bodies of the higher animals, are the causes of such diseases as anthrax, tuberculosis, and glanders in the lower animals, and of scarlet fever and other eruptive fevers in man. Indeed, **all communicable diseases** are probably **dependent on** such **micro-organisms.** In his admirable work on Pharmacology, Thera-

peutics, and Materia Medica, Dr T. Lauder Brunton states:—"It is probable that bacteria are constantly entering the organisms of men and animals from the lungs and digestive canal; but unless they are excessive in number, and virulent in their nature, they are quickly destroyed. When only a small number of pathogenic bacteria, such as the bacillus anthracis, is injected into the blood at once, they are destroyed in the organism; but when they are in larger numbers, they have the best of the struggle, and the organism itself is destroyed." It has recently been demonstrated that bacilli and their spores are attacked and destroyed in healthy subjects, under favourable conditions, by leucocytes, white blood corpuscles, connective tissue cells, and probably other healthy textures.

Regarding the development of bacteria, and their influence in producing disease, an important problem yet requires to be solved. It is still uncertain whether the several species, genera, or even orders, are fixed, or whether differences in surroundings can gradually change a **harmless** into a **hurtful bacteria.** In evidence of the possibility of such change, it is stated that the hay bacillus, by cultivation, has been converted into the deadly anthrax bacillus; while other observers declare that the micrococci on furred tongues or in ordinary sore throats closely resemble in all their features those of diphtheria, with the single exception that they grow more slowly. Conversely, it is certainly proved that active pathogenic bacilli, by cultivation, lose their destructive powers. Should it be demonstrated that innocuous can thus be converted into hurtful bacilli, it will be specially needful to understand, and if possible avert, those conditions which lead to such dangerous changes.

Another phase in the operation both of organic and organised ferments requires notice. In breaking up complex vegetable and animal constituents, they frequently **produce bodies of great activity.** The emulsin, the ferment of bitter almonds, gives rise to a hydrocyanated oil. The myrosin of mustard seed develops the acrid mustard oils. Some mushrooms produce the poisonous alkaloid muscarine; putrefying yeast yields sepsine; from putrefied maize is obtained an extract which

contains one substance which tetanises and another which narcotises. Many other albuminoids, when decomposing, yield alkaloids which increase animal temperature, cause septicæmia, and otherwise interfere with health.

The alkaloids resulting from putrefaction are termed **ptomaïnes**; and it is often difficult to determine, alike in surgical and medical cases, the proportion of mischief which results from them, and from the bacteria which have produced them. After active exertion, there are found in healthy muscles of living animals alkaloids allied to xanthin and creatin. It has also been recently shewn that during digestion of fibrin by pepsin an alkaloid is formed. Such alkaloids, developed by decomposition of albuminoids, independently of putrefaction and bacteria, have received the name of **leucomaïnes.** The importance of these alkaloids in relation to animal health is thus insisted on by Dr Lauder Brunton:—"It is probable that a considerable production of alkaloids takes place in the intestine, both when the digestive processes are normal, and more especially when they are disordered; at the same time alkaloids are being formed in the muscles, and possibly also in other tissues. Were all the alkaloids to be retained in the body, poisoning would undoubtedly ensue; and Bouchard considers that the alkaloids formed in the intestine of a healthy man in twenty-four hours would be sufficient to kill him if they were all absorbed and excretion stopped. He finds that the poisonous activity of even healthy human fæces is very great; and a substance obtained from them by dialysis produced violent convulsions in rabbits. When the functions of the kidney are impaired, so that excretion is stopped, uræmia occurs; and Bouchard would give the name of stercoræmia to this condition, because he believes it to be due to alkaloids absorbed from the intestines. He also thinks that the nervous disturbance which occurs in cases of dyspepsia is due to poisoning by ptomaïnes. That alkaloids are excreted by the urine has been shewn by Bocci, who has found in the urine a substance having an action like that of curare" (pp. 101, 102).

Many agents retard the action of ferments, and some effectually destroy them. These agents have been designated:

ANTIZYMOTICS—remedies which **arrest fermentation.** They

destroy the several classes of ferments. They include corrosive sublimate; chlorine, iodine, bromine; sulphurous, carbolic, boric, salicylic, and benzoic acids; many metallic solutions; temperatures above 200° Fahr., etc.

ANTISEPTICS—remedies which **arrest putrefaction.** They are a variety of antizymotics. They kill or prevent the development of those bacilli or spores which produce septic decomposition.

DISINFECTANTS **destroy the specific poisons of communicable diseases.** Their special function is to kill or arrest the development of those germs or microbes which produce disease.

DEODORISERS or **deodorants destroy smells.** Some of the most disagreeable smells, and those most injurious to the higher animals, result from putrefaction, and their cause is hence removed by effectual antiseptics. Smells consisting mainly of sulphuretted hydrogen are neutralised by chlorine; those from ammoniacal gases by hydrochloric or nitric acids. Noisome odours may also be attracted and absorbed by freshly-burnt charcoal or dried earth.

Enzymes generally have their action arrested or are destroyed more readily than the organised ferments, amongst which there is much difference in viability. Microzymes are more sensitive than bacilli. The bacillus anthracis is more easily killed than some others. The **spores** of all species are **specially resistant,** and, for their effectual destruction, require prolonged exposure to tolerably strong solutions of potent antiseptics.

The action of **watery solutions** of **various drugs on** the several **enzymes** has been carefully examined by Wernitz, and his experiments corroborated and quoted by Dr Lauder Brunton. Corrosive sublimate stands pre-eminent in the certainty of its effects, even in very diluted solution. The action of emulsin was arrested by 1-65,000th part, of diastase by 1-50,000th part, of ptyalin by 1-52,000th part, of pancreatin by 1-21,600th part; but it took 1-1766th part to arrest the action of pepsin, and 1-720th part to arrest that of rennet. Minute quantities of copper sulphate, chlorine, iodine, and bromine, and also bleaching powder and sulphurous acid, readily destroy these organic ferments. Salicylic and benzoic acids and

lime chloride are also effectual, usually in proportions of about 1-1000th part. Borax is effective generally with 1 to 100, although 1-3580th part arrests the action of the intestinal ferment invertin. Aluminium acetate, carbolic acid, and glycerine, in the order mentioned, are weaker still. Chloroform, thymol, eucalyptol and mustard oils have little, if any, action, even in saturated solution. A temperature over 125° Fahr. weakens or destroys the enzymes.

The relative influence of different drugs on different ferments is noteworthy. While 1-52,000th part of corrosive sublimate, as already indicated, arrests the action of ptyalin, 1 part in 720 is needful to arrest the action of rennet, which is, however, destroyed by 1-1000th part of borax, 1 part of which in 100 is required to destroy ptyalin. For destruction of rennet, bromine and lime chloride are specially effective. Creosote, although it has small effect on the enzymes, in solution of 1 part to 500, destroys yeast cells, and, in solution of half that strength, kills bacteria.

The mould fungi are destroyed by the same agents which kill yeast and bacteria.

Bacteria of **different sorts** exhibit some differences in their susceptibility to different antiseptics; indeed, the susceptibility somewhat varies in the same bacteria, when raised in different media. It is more easy to prevent than to arrest development of bacteria. As already pointed out, the spores have much greater resisting powers than the fully-developed bacteria. The perfect plants are destroyed by exposure for an hour to a temperature of 150° to 160° Fahr., but their spores require an exposure to 212° Fahr. Moist heat, having a greater power of softening and penetrating the spore envelope, is more effectual than dry heat. Milk containing the bacillus of tubercle or other specific disorder, may be rendered innocuous by five minutes' boiling.

Experiments bearing on the power of different substances to prevent the development of bacteria in various stages and solutions, to kill them, or to arrest development and reproduction of their spores, have now been carried out by many good observers. The plan of procedure has generally been to add to carefully-prepared sterilised fluids in test tubes,

known quantities of the disinfectant to be tested, and then introduce a drop of liquid containing bacteria or their spores. Such experiments show that the agents which most promptly and effectually arrest the action of enzymes also prove the most destructive to bacteria. Of **corrosive sublimate,** 1-5805th part kills the developed parasite; 1-25,250th part prevents the development of bacteria taken from meat infusions; but it requires 1-2525th part to prevent reproduction of spores in unboiled meat infusion, and still stronger solutions to penetrate and kill the spores. Chlorine, chlorinated lime, bromine, iodine, quinine, and beberine stand next in activity. Sulpho-carbolates and strychnine follow in order. Sodium sulphate is about 1-10th the strength of quinine. Compared with corrosive sublimate, the destructive effects of thymol, salicylic acid, and potassium permanganates are 1-20th in preventing development of bacteria, and less than 1-60th in preventing reproduction of spores. Sodium hyposulphate has very little action. Carbolic acid did not stand so high as expected. The fresh blood of an animal just dead from anthrax must be mixed with its own bulk of a 1 per cent. solution in order to destroy the bacilli, and enable it, without harm, to be injected into another animal. A ½ per cent. solution fails to destroy the bacilli.

Koch's experiments with the spores of anthrax bacillus constitute the most recent, extensive, and reliable **tests** of **the value** of **disinfectants.** Solutions of the several substances, of specified strength, were placed in tubes, their mouths stopped, as is generally done, by cotton wool; and threads steeped in fluids containing bacilli and their spores were carefully introduced. Some of these threads were removed from day to day, and subjected to microscopic examination. Even after one hundred days' exposure to the antiseptic, some threads still exhibited bacilli. Chlorine water freshly made, bromine 2 per cent. solution, iodine 1 part in 7000, corrosive sublimate 1 per cent. in water, were found effectually to destroy these anthrax spores with which they had been in contact one day. Formic acid, specific gravity 1120, destroyed all spores after four days' exposure. In five days all spores were killed by 5 per cent. watery solutions of lime chloride and ferric chloride. One per cent. of arsenic in water, and the same proportion of quinine in

acidulated watery solution, were effective in ten days. Oil of turpentine took five days, ether thirty days. The results with carbolic acid were disappointing; a 1 per cent. solution had not much effect on the spores, even when exposure was prolonged for fifteen days; and a 5 per cent. solution was required to secure their destruction in one day. Like salicylic, boric, and benzoic acids, sodium chloride, and many metallic solutions, carbolic acid was thoroughly effectual in destroying microzymes which had not formed spores, and, from its volatility, it is frequently more serviceable than fixed antiseptics. The infected threads, subjected to the influence of even the least active of those antiseptics, produced only scanty and retarded crops of bacilli. Solutions in alcohol, ether, or oil, even of such reliable antiseptics as corrosive sublimate, bromine, or iodine, were not nearly so effectual as their solutions in water.

The uses of antiseptics.—In surgery, zinc and iron chlorides, pitch and tar, tinctures of myrrh, and benzoin, and various other balsams have long been used empirically both in human and veterinary medicine. It was reserved, however, for Sir Joseph Lister to inaugurate a more effective and scientific system of antiseptic surgery. By the employment chiefly of **carbolic acid** in spray solution and gauze, bacteria are prevented from getting access to wounds, and suppuration, gangrene, and general septic poisoning can thus be averted. It is more easy to keep bacteria out of wounds than to get rid of them when they have made an entrance. Wounds which have remained for some hours exposed before being bound up with antiseptic dressings, should be thoroughly cleansed, washed, and if need be, syringed with a watery solution of corrosive sublimate, zinc chloride, or carbolic acid. When used at once for serious contused wounds, such antiseptics frequently coagulate and preserve outpoured blood and serum, and prevent their breaking up. Until granulation has made good progress, wounds should be kept covered by protective antiseptic gauze, or other dressing. Under carbolic spray, abscesses and bursæ are opened with greatly reduced risks of destructive inflammation and suppuration. **Salicylic** and **boric** acids are non-volatile, non-irritant antiseptics, and are often serviceable where carbolic acid has for some time been persevered with, where frequent dressings are unnecessary, or where granu-

lations and growth of skin require encouragement. The watery solution of sulphurous acid is a cheap, effectual, and soothing antiseptic. Chlorinated soda solution is sometimes also used, and iodine tincture diluted according to circumstances likewise proves a valuable stimulant and antiseptic. Iodoform conjoins the advantages of an antiseptic and anæsthetic. In order to prevent wounds being inoculated by septic germs, the knives, probes, ligatures, sponges, as well as the hands of the operator, must be repeatedly moistened with carbolic solution.

Antiseptics used internally are neither so certain, nor so effective as when used externally. Bacteria within the living body are not so easily got at, or destroyed; and, moreover, medicines such as corrosive sublimate and carbolic acid, which readily destroy the micro-organisms, are also liable to poison the patient. Dr Cash, however, has found that the continued administration of minute doses of corrosive sublimate render animals capable of resisting the deadly effects of the subsequent inoculation of anthrax. Professor Polli of Milan found that dogs, which for five days previously had received daily doses of sodium sulphite, suffered comparatively little inconvenience from the inoculation of fœtid pus, which destroyed with gangrene and typhoid symptoms, dogs not previously protected by the antiseptic. Mr Crookes *(Third Report of the Cattle Plague Commission 1866)* injected into the veins of a cow affected with cattle plague 105 grs. of carbolic acid, dissolved in six ounces of glycerine and water. Not only were no bad effects produced, but the cow steadily improved and recovered. But even more to the purpose, as showing the efficacy of the administration of antiseptics, are the observations (also made by Mr Crookes) that cattle in plague-infected buildings, receiving daily an ounce of carbolic acid along with their food, and having carbolic and sulphurous acid fumes frequently liberated in their sheds, did not catch the contagious plague. Researches in this direction will probably lead to important results.

For preventing decomposition of the contents of the stomach, and allaying irritation and vomiting, such antiseptics as creosote, carbolic acid, and sulpho-carbolates, with salicylic and sulphurous acids are administered. They are also sometimes equally useful in diarrhœa and dysentery. The notable efficacy of mercurials

in many of these cases is believed to depend upon their antiseptic properties. To check developement of bacteria when they have got into the blood, and to limit their injurious effects, the more active antiseptics, such as corrosive sublimate, carbolic acid, and creosote, require to be used with the utmost caution. In the treatment of phthisis in human patients, inhalation of spray, containing very minute quantities of corrosive sublimate, has recently, however, been successfully used. The ethereal oils, alcohol, and eucalyptol, salicylic acid, and salicylates, are safe and useful antiseptics for internal administration. Hydroquinine, kairin, antipyrin, antifebrin, and other antipyretics doubtless owe their effects to their controlling development of bacteria, and their products.

The uses of Disinfectants. Perfect cleanliness of the animals and their surroundings, with abundance of pure air and water, are the chief purifying agents requisite, so long as animals are in perfect health. When, however, **contagious** or **zymotic disease** occurs, it is necessary to destroy the specific micro-organisms produced, and prevent their diffusing and attacking healthy subjects. **Pure air** dilutes, but it also diffuses, and does not destroy these contagious organisms.

Water, like air, mechanically dilutes noxious matters, and hastens their oxidation. Sewage freely mixed with running water is hence rapidly decomposed and robbed of injurious properties. Insufficiently diluted with water, decomposing organic and contagious matters, instead, however of being deprived of their activity, are apt to get distributed, and are liable to assume more dangerous forms. Hence, in purifying foul or infected places, solid accumulations should be mixed with some fitting antiseptic, and removed without the addition of water. Infected stables, sheds, market-stances, trucks, or ships should be swept out, and, if need be, scraped; and dry or semi-solid filth, which proves so ready an absorbent of contagious virus, should be mixed with M'Dougall's disinfecting powder, and cleared away. The partially cleansed surfaces should then be well washed with carbolic soap and water, or corrosive sublimate solution; brick-work subsequently lime-washed, and wood-work sprinkled with crude carbolic acid in the proportion of two ounces to the gallon of water

It is of paramount importance to attack the infecting micro-organisms so soon as they are produced, and before they have opportunity for distribution. Animals affected with contagious diseases should, accordingly, be immediately **isolated**, provided with attendants who shall have nothing to do with the healthy stock, their droppings at once disinfected, their skins and feet washed daily with some antiseptic, whilst antiseptic medicine should be given internally.

In infected sheds or stables occupied by animals, **chlorine** or **sulphurous acid** should be used several times a week. The former is the more effectual. Half-a-pound of sulphur, mixed with about one-fourth part of charcoal, and placed in a chaufer or on a shovel of hot cinders, fumigates a shed about 100 feet long, and 20 feet in breadth and height; and, if the business is properly managed, it need cause no pulmonary irritation, either to the animals or their attendants. **Carbolic acid** in its impure liquid form is conveniently applied with a brush over the doors, walls, and mangers; and M'Dougall's carbolic powder should be scattered over the floors and manure heaps daily. Rugs, pieces of carpet, or sacks, wetted with a strong solution of the volatile carbolic acid, should be hung about the premises.

The reporters to the Cattle Plague Commissioners adduce many striking cases showing the **efficacy of disinfectants.*** Mr William Crookes and others used carbolic and sulphurous acids on many farms during the prevalence of cattle plague, and these herds, although in the midst of active centres of contagion, escaped. Nay, more, individual animals breathing an atmosphere of carbolic acid, and receiving daily doses of the acid with their food, resisted the contagion for weeks, although plague-stricken subjects were dying in adjoining standings. One herd of seventy-three animals in Cheshire was for months surrounded by cattle plague. The virus was eventually conveyed to them by one of the milkmen. Four of the cows milked by him sickened and died; twenty-eight younger animals, unprotected by disinfection, also caught it and perished; but disinfection, continuously applied, effectually arrested further spread of the

* Reports of the Commissioners appointed to enquire into the origin an nature of The Cattle Plague, 1866.

disease. From the end of February until the middle of April no new cases occurred. The disease abating in the neighbourhood, the forty-one surviving cows were turned out to grass; within, however, a few days of their removal from the protecting influence of the disinfectants, they were, one after another, struck down by plague, and all died. Carbolic acid sprinkled about the boxes, sheds, and enclosures of the Jardin d'Acclimatation, in Paris, proved successful in preventing the spread of cattle plague in 1865. Similar treatment has secured the like immunity from attacks of contagious pleuro-pneumonia and foot-and-mouth disease. Repeated instances have come under my notice, where foot-and-mouth disease has been arrested after a portion of the herd has been attacked, by washing twice a week the walls, floors, doors, and other woodwork of the infected premises with carbolic acid, confining the animals for several weeks to their sheds or boxes, and keeping them surrounded by, and breathing an atmosphere abounding in the tar acids, freshly evolved by sprinkling M'Dougall's powder daily over the floors and the manure. By similar disinfection, the progress of influenza in large stables has been greatly abated, and the virulence of the disease mitigated.

Burning is the only absolutely safe method of dealing with the bodies of anthrax subjects, from which removal of the hides is dangerous, alike to persons employed, or, it may be, to other animals; cattle plague and swine-fever cases should either be burned or deeply buried; while for the diseased organs of tuberculous patients, the furnace is the only safe tomb.

A **high temperature,** as already indicated, destroys infective particles. Koch, as above stated, found that the bacilli of anthrax and swine-fever, even when bearing spores, were deprived of pathogenic power when exposed for four hours to a temperature of 216° to 220° Fahr.; while exposure for five minutes to boiling water, or, better still, to **steam heat,** is equally effective. The power of steam depends (1) On its latent heat; (2) on its moistening; (3) on its condensing; (4) on its penetrating. It is most effective when employed under pressure, and when its entrance into the chamber is occasionally interrupted, so that cold air in the interstices of bulky and non-conducting bodies may be displaced. Dr Russell, Medical Officer

of Health, Glasgow, exposes all infected washable articles for three-quarters of an hour in a chamber to steam heat, along with soap and soda, and finds that this treatment destroys bacilli of anthrax and swine-fever, tuberculous pus, and also the ova of lice. This method should, where practicable, be adopted in the case of rugs and other articles used by infected animals. Leather straps should be removed from horse-cloths before they are exposed to the steam, which destroys them; but they may be readily disinfected by carbolic or corrosive sublimate solutions.

The **conveyance** of contagion **by attendants** is prevented by sprinkling their clothes with weak carbolic solutions. After touching animals affected by contagious disease, or making post-mortem examinations of such subjects, the hands should be cleansed, first with soap and water, and then washed with a 2 per cent. solution of carbolic acid, or with a solution of 12-15 grains corrosive sublimate to a quart of water, which very effectually destroys any adhering bacilli.

So soon as the premises in which animals affected with contagious disease have lived can be emptied, thorough disinfection should be carried out. To this end, doors and windows having been closed, chlorine or sulphurous acid should be freely evolved, and the place kept shut up for several hours. Walls, floors, and woodwork should subsequently be scraped, and washed with corrosive sublimate solutions.

Different disinfectants are suitable for different purposes. When putrefying or contagious matters have been freely mixed with water, the best are mineral salts, of which the most effective and cheapest are corrosive sublimate; zinc chloride, in the familiar form of Sir William Burnett's disinfecting fluid; and iron chloride, the active constituent of Ellerman's deodorising fluid. For sewage disinfection, or where there is much water, aluminium sulphate, followed by lime, is also recommended. Sulphites promptly remove smells, and are most effectual when conjoined with the tar acids. The mixture of sodium sulphite and carbolic or cresylic acid, although effectual for deodorising, has a feeble power in preventing the putrefaction of night soil, and when remaining for a day or two freely dissolved in water they give off sulphuretted hydrogen. Common salt, although ineffectual in checking decay when once established, or of neutralising bad

smells, is a cheap preserver of many animal substances. It preserves and disinfects skins. For preserving for manure meat seized as unfit for human food, Cooper's salts, consisting of refuse commercial chlorides, are cheap and effectual. Iodine is volatile and penetrating. Mainly on Dr B. W. Richardson's recommendations, it is used in many sick-rooms and hospitals, conveniently dissolved in the light diffusible amyl-hydride. The solution contains 20 grains to the ounce; an ounce suffices for every four feet of cubic space; distributed by a spray producer, it volatalises rapidly; it leaves, when freely used, a film of iodine, and effectually destroys smells and noxious organic matter. Its expense, however, precludes its general use in veterinary practice.

The uses of Deodorisers. Bad smells, however unpleasant, are not necessarily prejudicial to health, and, although sometimes associated with, are perfectly distinct from, the micro-organisms of zymotic or contagious diseases. Objectionable smells are largely made up of sulphuretted hydrogen, phosphuretted hydrogen, and nitrogen gases, with sulphurous and ammoniacal compounds. Still more injurious are the noisome exhalations from the skins and lungs of animals. Some popular deodorisers only cloak and overpower, instead of neutralising or destroying, odorous principles. Of this description are fumigations with aromatic and balsamic substances, such as camphor, cascarilla, and lavender, the burning of brown paper, the sprinkling of scents and essences. Odours depending upon gases are readily removed by effectual chemical neutralisers: sulphuretted hydrogen, by chlorine; ammoniacal emanations, by hydrochloric or nitric acids. Smells from decomposing organic matters are usually most effectually got rid of by arresting decomposition by suitable antiseptics. Noisome odours already floating in the air may be attracted and absorbed by freshly-burned charcoal, dried earth, or cotton wool; or altered and broken up by such gases as chlorine or sulphurous acid. For destroying the intolerable smell from the cochineal dye-works, no deodoriser has been found so effectual as sulphurous acid. For deodorising the contents of privies, without detracting from the manurial value, a mixture of common salt and carbolic acid is effectual; or eight parts of calcined dolomite mixed with two of peat or wood charcoal.

Powerful mineral antiseptics, such as the zinc and iron chlorides, especially when used in concentrated solution, are not good deodorisers. They are apt to evolve disagreeable fatty acids. Not being volatile, they can only destroy the odorous particles brought into immediate contact with them. The like objection of being fixed, and hence unable to seek out the floating odorous matters, stands against the exclusive use of the permanganates in their handy form of Condy's fluid. Iodine, dissolved in amyl-hydride, although an expensive, is an elegant and effective deodoriser. In unoccupied places with closed doors, the iodised solution may be freely distributed by a spray producer. Cresylic and carbolic acids are good deodorisers, are volatile, but have the disadvantage, when used in concentrated form and in presence of much water, of evolving sulphuretted hydrogen. A mixture of dry sodium sulphite with carbolic acid is effectual, and moderate in cost, and should be placed in vessels distributed about the premises. M'Dougall's disinfectant powder is also good, especially when charged with an extra quantity of carbolic acid; animals appear to have no dislike to the tar-like odour, and nothing answers better for removing the smell and arresting the decomposition of stable or other manures. Lime chloride, in the familiar form of bleaching-powder, although possessed of small antiseptic power, is a prompt and effectual deodoriser, can be employed either for solid or liquid impurities, gives off gaseous chlorine, and never causes any disagreeable combinations; but breaking up instead of preserving organic matters, it diminishes the value of manure with which it is mixed. It is applied as powder, or in solution containing from 2 to 5 per cent., to the walls, woodwork, and floors of the places requiring purification, or sheets soaked in the solution are suspended about the premises.

Antiperiodics are remedies which mitigate the severity, or prevent the recurrence of attacks of certain diseases. The febrile symptoms of influenza in horses occasionally exhibit periodical aggravation, but intermittent seizures are greatly less frequent in the lower animals than in man. The production of such disorders is believed to be connected with the recurring production of fresh crops of micro-organisms. Cinchona, quinine, and arsenic, are the most effective antiperiodics.

MEDICINES ACTING ON MUSCLES.

MUSCULAR POISONS—MUSCULAR STIMULANTS.

Muscles possess **extensibility** and **retractility.** Heat renders muscles less extensible and more retractile; Cold, and section of an important nerve, have the opposite effects. Fatigue and acids, notably lactic acid, one of the products of muscular waste, increase extensibility. Very dilute alkalies diminish extensibility. **Irritability** is increased by heat and physostygmine; while it is diminished by cold, curare, and other substances which cause muscular paralysis. **Contraction** and **relaxation** of muscles, possibly consisting, like other forms of motion, in waves of vibration, appear to be connected with some chemical changes in the muscle resembling oxidation; oxygen is used up, while sarco-lactic, and subsequently carbonic acids are formed. These products, and the accompanying fatigue consequent on repeated violent contractions, are removed experimentally by washing out the muscle with a current of blood. A saline solution, notably potassium permanganate, by ready oxidation, causes similar results, which likewise follow the use of a mere trace of veratrine. In practice, removal of these waste products is hastened by shampooing the muscles or massage, the effects of which, in overcoming fatigue, are fully recognised. In like manner the thorough grooming and diligent hand-rubbing of the limbs of horses after a hard day's work, lessens fatigue, as well as prevents subsequent stiffness and fulness of joints and bursæ.

"Rapid alternation of contraction and relaxation, or **tremor,** may affect either—*(a)* a few bundles of muscular fibres; *(b)* a single muscle; or *(c)* groups of muscles" *(Brunton).* Such tremors may occur when the muscle is at rest or when it is in motion. This form of insubordination may probably result from the number of stimuli from the nerve centre being either too few or too many. If the stimuli are insufficiently rapid, veratrine or calcium salts, which increase the duration of each individual contraction, are recommended. When a muscle, or its motor nerve, receives an abnormal number of vibrations, or is over stimulated, instead of contraction being followed by relaxation, permanent contraction or **tetanus** ensues.

Muscular poisons are divided by Dr Lauder Brunton into the following six groups:—

1. Leaves the irritability of the muscle unaffected, but diminishes the total amount of work it is able to do. This group contains apomorphine, saponine, copper, zinc, and other emetics. Antimony, arsenic, and large doses of iron have somewhat similar, but weaker effects.
2. Diminishes the excitability of the muscle, as well as its capacity for work. This group contains salts of potassium, lithium, and ammonium, the cinchona alkaloids, chloroform, and alcohol, in large doses.
3. Diminishes the capacity for work, and produces marked irregularity in its excitability, and contains lead, emetine, and cocaine. Similar effects are also produced by ptomaïnes.
4. Alters the form of the muscular curve, as exhibited by veratrine, and to a similar, although less extent, by strontium and calcium salts.
5. Increases the excitability, as is notably done by physostygmine.
6. Increases the capacity for work. The drugs belonging to this group cause rapid restoration of the muscle after fatigue, and are represented by creatin, hypoxanthin, caffeine, and glycogen. These substances must hence be regarded, not only as nerve stimulants, but as direct muscular restoratives.

Voluntary muscles differ from involuntary, not only in structure, but in other particulars. Their contraction and relaxation are more rapid. They do not so frequently exhibit those rythmical contractions, which are an inherent property of contractile tissue, and are independent of its nerve ganglia. The nerves in voluntary muscles terminate in end-plates, while the terminal twigs in involuntary muscles form a plexus round the fibres. Curare, in small doses, paralyses the motor nerves of voluntary muscles, but must be used in much larger doses to paralyse the nerves of involuntary muscles. On the other hand small doses of atropine paralyse involuntary muscles, while much larger quantities are required similarly to affect voluntary muscles. Striking illustrations of the different effects on these two classes of muscle are recorded by "Szpilman and

Luchsinger, who found that atropine produces paralysis of the motor fibres of the vagi supplying the œsophagus, only in those parts of it where involuntary muscular fibre is present. Thus the œsophagus of the frog, and the crop of birds, consist of involuntary muscular fibre, and atropine destroys the motor power of the vagus over them. The œsophagus of the dog and rabbit contains striated muscular fibre, and atropine does not paralyse the motor nerves. The œsophagus of the cat contains striated muscular fibres, in its upper three-fourths, and non-striated in its lower fourth; atropine destroys the motor action of the vagus upon the lower fourth, but not upon the upper part" *(Brunton).* The paralysing effects of drugs upon muscles are believed to result from their disturbing the relations between the nerves and the muscular fibres which they excite.

MEDICINES ACTING ON THE NERVOUS SYSTEM.

On the Brain. — CEREBRAL STIMULANTS — EXHILARANTS — CEREBRAL DEPRESSANTS—SOPORIFICS—NARCOTICS—ANODYNES —ANTISPASMODICS—ANÆSTHETICS.

On the Spinal Cord.—SPINAL STIMULANTS AND DEPRESSANTS.

On Motor Nerves.—STIMULANTS—PARALYSERS.

On Sensory Nerves.—STIMULANTS—LOCAL SEDATIVES—LOCAL ANÆSTHETICS—ELECTRICITY.

The nervous system of the higher animals comprises:—

I. The brain, which takes cognisance of external impressions, co-ordinates movements, and originates mental or psychical ideas. Relatively to other parts of the nervous system, the brain of man is more highly developed than that of other animals, and most drugs, accordingly, act upon it more powerfully than upon the less developed brains of horses, cattle, or dogs. The cerebellum is chiefly concerned in the maintenance of equilibrium.

II. Extending from the brain is the spinal cord, through which sensory impulses are conveyed to the brain and medulla, and whence motor impulses are transmitted to muscles and glands. The cord, moreover, in several ways, transmits and regulates reflex actions. That part

of the cord, or, indeed, of the nervous system, most essential to life, is the medulla, in which are situated the resipratory cardiac, and other vital centres.

III. Nerves of sensation, distributed to all parts of the body, convey impressions to the brain or cord.

IV. From the cerebro-spinal axis originate nerves which give motion to muscles, and convey other efferent impulses to glands.

Concerning the functions and diseases of the nervous system much has still to be learned, while the effects of medicines acting upon it have only recently been thoroughly examined, and still require much investigation.

The brain of the higher animals comprises:—

I. Motor centres, arranged along the two sides of the fissure of Rolando, and chiefly employed for the purposes of seeing food, masticating it, and moving the fore limbs.

II. Sensory centres, for seeing, hearing, and taste, which are arranged in the posterior and lower parts of the brain; and others, for general sensation, which lie more interiorly in the hippocampal region.

Medicines affecting the brain act either directly on the **nerve-cells,** or on **the general circulation.** Blood flowing freely through the brain increases its excitability; insufficient circulation diminishes excitability. Many medicines, such as alcohol and ether, act both directly on the nerve-cells and on the general circulation. They stimulate nerve-cells of all descriptions, wherever found, act on most of the brain-centres, and, according to the dose in which they are given, are stimulants or depressants. Full doses very frequently exert primary stimulant, and secondary depressant, effects. Such medicines as opium, alcohol, and ether, according to dose, are stimulant, narcotic, soporific, or anæsthetic.

The cerebral motor centres have their **excitability lowered** by alcohol, chloral, and cold. The depression caused by cold, unless extreme, or applied for a long period, is followed, however, by reaction. Bromides of potassium and ammonium, without disturbing the relations of one centre to another, appear to have a marked effect in lowering general brain activity. Still more prompt and powerful are anæsthetics, which abolish

all motor action. Atropine in small doses increases, but in large doses diminishes, motor excitability.

The motor centres have their **excitability increased** by mechanical irritation, as by the point of a needle, which produces epileptic convulsions. But similar convulsions also ensue when the vessels of the brain are surcharged with venous blood, as in asphyxia. Camphor causes excitement, and constant movements, succeeded, in large doses, by clonic epileptic convulsions and death. The active principles of Coculus indicus, Cicuta virosa, and Œnantha crocata, as well as cinchonidine and quinine, have similar convulsant effects. The action of these agents is not confined to the brain motor centres, but also extends to those in the medulla.

Cerebral stimulants.—The functions of the brain generally are stimulated by a large group of agents, sometimes termed **brain stimulants** or **exhilarants,** and exemplified by the alcohols, ethers, and oil of turpentine. A moderate dose of alcohol, in a somewhat concentrated state, by stimulating the sensory nerves of the mouth, throat, and stomach, promptly exerts a reflex action on the vessels of the brain. Further, but less direct and powerful, brain stimulation ensues when the spirit enters the circulation and increases cardiac action. Where a large dose has been administered, the cerebral exhilaration is not, however, long continued; the normal relations between one part and another are disturbed, delirium ensues, followed by impaired action and depression. Ammonia vapour, liquor, or carbonate, applied to the nostrils, reflexly stimulates the cerebral vessels, and presently acting upon the vaso-motor centres, also increases general blood circulation and pressure. Brisk exercise has much the same stimulating effect on the cerebral as on other arteries and capillaries. Mastication and sucking in young animals are shown, by experiment, to increase circulation in the carotids and cerebral arteries. The chewing of tobacco, betel-nut, or indeed, anything else, smoking, and sipping stimulants, or even tea, coffee, or cold water, have similar effects in dilating the human cerebral arteries. Placing the head on the same, or on a lower level than the rest of the body, favours brain circulation, and hence wards off syncope.

The **functional activity** of the brain is **lowered** by large or

repeated doses of stimulants, such as alcohol, which, after exhilaration, and, it may be, delirium, produce narcosis, sleep, and sometimes death. Bromides of potassium and ammonium, without preliminary excitement or disturbed function, diminish brain activity. Accumulation of lactic acid, and probably other elements of tissue waste, appears to have an effect similar to that of the bromides in lowering the powers of the nerve-cells.

Soporifics or **Hypnotics** are agents which induce sleep. In suitable doses, they do not disturb the normal relations of the mental functions to the external world, as is done by narcotics. They lessen functional activity of the nerve cells of the brain and spinal cord, and even to some extent that of the respiratory and vaso-motor centres in the medulla, as evidenced by slower respiration, dilatation of surface-vessels, and lowering of arterial tension. During sleep the cerebro-spinal system becomes anæmic. Certain parts, remaining in a state of partial, unregulated activity, induce the phenomena of dreams, which occur almost as much amongst the domesticated animals as in man.

The most effectual hypnotics are opium, morphine, chloral hydrate, croton-chloral, hyoscyamus, cannabis, and bromides. Their effects are more certainly secured by prescribing several together. Opium or morphine proves of special value not only in depressing functional activity of the brain, but also in antagonising most descriptions of pain and irritation which interfere with sleep. Bromides notably quiet cerebral excitement in men, dogs, and also in horses. Chloral induces sleep mainly by its action on the brain, and its dilating vessels generally. Warmth to the body and legs, and the swallowing of a comforting, warm drink, withdraws blood from the brain, and hence favours the anæmia, which results in sleep.

Narcotics are drugs which disturb the relation of the mental faculties with the external world. This disturbing effect is produced by full doses of alcohol, ether, chloroform, and most stimulants. After a variable amount of excitement, paresis of co-ordination ensues, and the animal staggers in its gait. Where the effect is still further developed, fatal paralysis of the respiratory centres occurs. Opium and Indian hemp produce little vascular excitement, and their narcotic effects are stated to be due chiefly to alterations in the relative functions of the different

parts of the brain. Belladonna and its analogues produce active delirium, perpetual movements associated with debility, and depending, Dr Lauder Brunton believes, on the "combined stimulant action of these drugs on the nerve-centres in the brain and spinal cord, and their paralysing action on the peripheral ends of the motor nerves."

Anodynes or analgesics are agents which relieve pain by diminishing excitability of nerves or nerve-centres. Pain may originate in the hippocampal region, which Professor Ferrier regards as the central seat of sensation, and some abnormal excitement of these nerve ganglia is believed to occur in hysteria. It may depend upon stimulation in the grey matter of the cord, through which painful impressions are conveyed. It may begin in the trunk of a nerve, although most frequently its origin is in the peripheral endings of the sensory nerves.

Anodynes may **act generally** or **locally.** Those acting generally, include opium and morphine, anæsthetics in small doses, belladonna, atropine, chloral, conium, hyoscyamus, stramonium, and their alkaloids. Local anodynes include those already enumerated, and also aconite, cocaine, veratrine, local blood-letting, warmth, as applied by poultices or fomentations, and cold in the form of ice-bags, or cold water.

Opium abates pain, however originating, for it diminishes the sensibility of all nerves and nerve-centres. Bromides have a similar, but much weaker, general power in combating nerve excitability. Chloral and Indian hemp appear to act especially through the brain-centres. Belladonna and its allies, with cocaine, aconite, and veratrine, owe their efficacy mainly to their diminishing excitability of sensory nerves. In relieving pain, it is almost superfluous to say that the cause of it should, if possible, be removed. Cold, dry or moist heat, or counter-irritation may be appropriate. Electricity applied along the course of the stimulated nerves, and, in acute rheumatism, nerve-stretching, are sometimes tried. Dividing the nerve leading from the seat of injury, as is done in navicular and some other diseases of the horse's limbs, prevents perception of pain, but of course does not arrest local inflammation or other mischief. In horses, as in other animals, a dose of physic is

often an effectual anodyne, probably owing to its relieving irritability of the cerebro-spinal centres.

Antispasmodics are agents which prevent or remove **spasm,** which is an irregular, injurious contraction of voluntary or involuntary muscles. It is defined by Dr Lauder Brunton as "a kind of insubordination, in which the individual muscles or nerve-centres act for themselves, without reference to those higher centres which ought to co-ordinate their action for the general good of the organism. It may be due, therefore, to an excess of action in the muscles or local centres, or diminished power of the higher co-ordinating centres. As a rule, it is due to diminished action of the co-ordinating or inhibitory centres, rather than to excess of action in the motor centres. It is, therefore, a disease rather of debility and deficient co-ordination than of excessive strength." Local irritation is the frequent cause of spasm.

Excessive exertion develops in the muscles of locomotion, especially when employed in unwonted work, waste products, which produce spasm or **cramp.** Both cause and effect are frequently removed by smart friction. "In the intestine, cramp may be due to the presence of a local irritant, which ought, in the normal condition, to produce increased peristalsis, and thus ensure the speedy removal of the offending substance. From some abnormal conditions, the muscular fibres around the irritant contract excessively, and do not pass on the stimulus to those adjoining. From this want of co-ordination, painful and useless spasm occurs. In order to remove it we apply warmth to the abdomen, so as to increase the functional activity both of the muscular fibres and of the ganglia of the intestine. Peristalsis then occurring instead of cramp, the pain disappears, and the offending body is passed onwards and removed. Or we give, internally, aromatic oils, which will have a tendency to increase the ordinary peristalsis; or, yet again, we may give opium for the purpose of lessening the sensibility of the irritated part, or the nerves connected with it, and thus again bringing it into relationship with other parts of the body" (*Brunton*). In the treatment of colic in horses, these several modes of attack are usually conjoined. A diffusible stimulant such as ether or alcohol, is given to increase the powers of the higher nervous

centres, and thus bring the disturbed lower ones and the muscles into subordination; an opiate is associated to lessen local excitability; while a purgative is, besides, administered in order to remove the indigestible food which is usually the cause of the mischief.

The convulsions of epilepsy are treated by alkaline bromides, and salts of silver, zinc, and copper. Chorea is combated by salts of copper and zinc, by arsenic and conium. Spasm of blood-vessels is controlled by amyl-nitrite and other nitrites. Camphor and bromo-camphor exalt the power of the brain and spinal centres, and thus control and co-ordinate the lower disturbed centres. The antispasmodic action of valerian, asafœtida, musk, castor, and aromatic oils, is probably similarly developed. Instead of exalting nervous excitability, another class of antispasmodics—such as borneol and menthol—lessen irritability, and paralyse motor, sensory, and reflex centres of the brain and cord, and thus often relieve spasm. Spasmodic diseases generally depending, as already indicated, on deficient and imperfect nervous power, restoratives, tonics, and good hygiene are essential factors in their successful treatment.

Anæsthetics are remedies which **diminish and abolish sensation.** They differ only in degree from anodynes. Both classes of agents diminish or destroy excitability of the cerebro-spinal system, and of sensory impressions, and hence prevent perception of pain; but anæsthetics produce their effects more promptly, and in full doses more notably paralyse the reflex centres.

Anæsthesia is generally divided into **four stages.** The first is that employed chiefly for anodyne, or antispasmodic effects. The second is required in order to moderate violent or irregular labour pains. In the third stage, the functions of the spinal cord, and, consequently, of reflex action, are abolished, as is usually ascertained by touching the conjunctiva, when no closure of the eyelid ensues. Such full insensibility is needful for the performance of serious surgical operations. This third stage with care may be maintained for many hours. In the fourth stage the respiratory centre becomes paralysed, respiration ceases, the heart beats are gradually enfeebled, and may stop altogether. This cardiac

arrest is more apt to follow the use of chloroform than of ether, and probably results in part from the tendency of anæsthetics to destroy the irritability of muscular fibre. Anæsthetics are protoplasmic, as well as nerve, poisons.

The dangers of anæsthesia depend on (1) an overdose of the agent; (2) on chloroform vapour in too concentrated a state, directly paralysing the heart; (3) on a combination of chloroform narcosis, and shock; (4) on suffocation caused by blood or vomited matters getting into the windpipe.

Anæsthetics **are used** in painful, serious, delicate, or protracted operations, as in castration of cryptorchids, removal of portions of hoof, and other such painful operations on the foot; herniotomy, excision of tumors; extraction of firmly fixed teeth, especially in dogs and cats; for parturition, especially in the mare; and for painless death of injured useless, or old animals.

The **anæsthetics** used to abolish sensation throughout the body **generally**, with the exception of nitrous-oxide, all belong to the class of **alcohols and ethers, with their substitution compounds.** Alcohol inhaled as vapour is itself a feeble anæsthetic. **Chloroform** is still generally used both in human and veterinary practice throughout Scotland, and is recommended by Professor W. O. Williams and Mr R. Roberts in their valuable paper on anæsthetics, read before the National Veterinary Association in Edinburgh in 1886. This paper summarised the experience of many eminent continental veterinarians regarding anæsthetics. In America, **ether** was first used, and is still preferred. In most of the veterinary schools throughout the continent of Europe, a mixture of about equal parts of chloroform and ether is employed, both for horses and cattle. In dogs the heart action is liable to be dangerously weakened by chloroform; from its use some French authorities state that a mortality of 5 per cent. occurs; and for dogs, accordingly, the proportion of ether is increased, or ether is used alone. Ether acts more slowly, and requires fully four times the dose of chloroform, but is not so apt to produce cardiac and vaso-motor paralysis, although it causes a greater extent, and longer duration, of relaxation of tendons. **Chloral hydrate** is given by the mouth or rectum, or by

intravenous injection, and in this last form a solution of one to three of water is stated to be the anæsthetic in general use at Alfort. But chloral hydrate and croton-chloral are weaker anæsthetics than either chloroform or ether, and, causing vascular dilatation, have the disadvantage of promoting hæmorrhage. **Nitrous oxide** produces its effects rapidly, induces a venous condition of the blood, with contraction of arterioles and rise of blood-pressure, and there is hence no risk of its causing syncope. In human practice, anæsthesia is sometimes induced by nitrous oxide, and subsequently maintained by ether. In all classes of patients, where deep or prolonged anæsthesia is needful, **morphine** should first be **subcutaneously** injected.

The dose of chloroform for adult horses ranges from 1 to 2 ounces; for cattle it is about 2 ounces; for dogs and cats from half-an-ounce to an ounce. Ether requires to be used in four or five times the quantity of chloroform. For dogs and cats half-an-ounce is allowed for every 2½ lbs. of the animal's weight. The dose of chloral hydrate for horses is 2 to 3 ounces; for dogs 15 to 60 grains. Young animals are more readily brought under the action of anæsthetics than old ones. By giving the anæsthetic rapidly, full effects may be produced in five to fifteen minutes, and with fresh supplies of the drug animals may, with care, be kept under its influence for several hours.

Administration to horses may be made while the animal is standing; but more commonly he is first cast and secured. A sponge or piece of lint, saturated with the anæsthetic, is placed in one nostril, that on the side farther from the ground being preferable, while, to prevent undue evaporation, a napkin is laid lightly over both nostrils. It is usually stated that the anæsthetic vapour should be inhaled diluted with about an equal volume of air. But chloroform requires more, and ether much less, dilution. Too large an admixture of air is inexpedient, as it retards full effects, and prolongs and increases the stage of excitement. Indeed, in using even chloroform, it is often desirable during inspiration, by pressure upon the nostril, to limit ingress of air, removing pressure, however, during expiration. So soon as anæsthesia is complete, the tongue, to prevent risk of suffocation, should be drawn a little way out of the mouth.

Dogs should not be anæsthised with a full stomach. For them the medicine is conveniently placed on a sponge or on lint, in a wire muzzle. Large or savage dogs are coaxed into a kennel, the entrance closed, and, from above, portions of cotton waste or blotting paper are introduced, saturated with the drug. Small dogs or cats speedily succumb when put into a box or tin pail, covered with a towel, on which successive quantities of the anæsthetic are poured. Rabbits, rats, mice, and birds, placed under a bell jar, with an opening at the top, are readily anæsthised by putting in successive portions of blotting paper, soaked in chloroform.

When anæsthesia interferes with the functions of circulation and respiration, and the **reflex irritability** of the conjunctiva—functions which throughout should be carefully watched, further administration of the medicine must at once be suspended, all impediment to the breathing of fresh air removed, ammonia held to the nostrils, cold water dashed over the head and neck, artificial respiration adopted, and ether subcutaneously injected.

The local anæsthetics consist of cold, usually applied in the form of ether spray, cocaine, carbolic acid and iodoform. By these agents paralysis and anæsthesia of a limited spot is induced, when slight operations may be performed, examination made of sensitive or painful parts, or pain relieved. For such purposes **Cocaine** is now generally preferred. The part is moistened with it, at intervals of five minutes, until the requisite insensibility is secured; four or five such applications are usually needful. Cocaine proves particularly serviceable in diminishing irritability and facilitating examinations of the eye and larynx, as well as for the performance of minor operations. For operations about the rectum or vagina **iodoform** is used, and advantageously conjoins anæsthetic and antiseptic effects.

ACTION OF DRUGS ON THE SPINAL CORD.

SPINAL DEPRESSANTS—SPINAL STIMULANTS.

The three prominent functions of the spinal cord are **enduction, reflex action,** and **origination** of nervous force.

On these functions different drugs act in various ways. Caffeine, injected into the circulation, was found by Dr Hughes Bennett to paralyse the sensory columns of the cord, while morphine and chloral diminish its conducting power. Antagonising these are strychnine and other convulsant poisons, which so increase excitability, that slighter stimulants cause increased effects. Reflex action is diminished by chloral and morphine, and is increased by strychnine and other convulsants, nicotine and ammonia.

Spinal Depressants, such as methyl-coniïne **directly paralyse;** others, as aconite and digitalis, produce **paralysis indirectly,** by impeding circulation; others have been thought to act on those portions of the optic lobes known as Setschenow's centres, and thus exert an **inhibitory** or **restraining** influence. Pharmacologists classify spinal **depressants** as (1) Those which **depress without marked previous excitement,** including hydrocyanic acid, methyl-coniïne, saponine, physostygmine, turpentine, the alcohol group, ergot, emetine, salts of antimony, zinc, and silver; (2) Those which **excite first** and **afterwards paralyse,** comprising the morphine group, ammonia, camphor, carbolic acid, chloral, nicotine, veratrine, arsenic, and mercury.

Spinal depressants are prescribed to **lessen increased excitability** of the cord, as in tetanus chorea, and some forms of paralysis. By diminishing the conducting power of the grey matter of the cord, they impede the transmission of painful impressions. It is often, however, difficult to determine in what particular way the curative effects of agents like morphine and chloral are produced, inasmuch as they act in various methods on different parts of the nervous system, developing now depressing, and now stimulating, effects.

Some of these divers results are believed to depend on the **inhibitory** or **restraining** power which certain of the nervous centres exert on other centres. But Dr Lauder Brunton propounds a more satisfactory explanation of the nature of inhibition. He believes that **nervous stimuli consist in vibrations** in nerve-fibres or nerve-cells, analogous to the vibrations of light or sound. When two waves of light or sound fall upon each other, so that their crests coincide, the intensity of the light or sound is increased; but when they

fall so that the crest of one wave occupies the trough between the two preceding or succeeding waves, such two waves of light cause darkness, or two such waves of sound cause silence. Moving the one wave forward or backward upon the other intensifies or diminishes the vibrations of light or sound "Supposing nervous stimuli to consist of vibrations like those of light and sound, the action which any nerve-cell would have upon the others connected with it would be stimulant or inhibitory according to its position in relation to them" (*Brunton*). If nerve-force, as believed, consists of vibrations similar to those of light or sound, the relative position of nerve-cells in action will often determine a stimulant or inhibitory result. If one nerve current meets another, in such a way that the waves of which they consist coincide, the the nervous action will be doubled, but if they interfere the nervous action will be abolished. If they meet so as neither completely to coincide nor to interfere, the nervous action will be somewhat increased, or somewhat diminished, according to the degree of coincidence or interference between the crests of the waves. The relation of these waves to one another may be effected by the distance each travels, and the rate of transmission.

This hypothesis seems to explain why different doses of **poisons** sometimes **produce** very **different results.** The phenomena of strychnine poisoning thus appears to depend upon the nervous vibrations being thrust crest upon crest, when intense convulsions occur; while, from one or other wave, dropping half a length behind, the interval of rest or relaxation follows. In like manner may be explained the similar effects of cold and heat. Cold retards transmission of vibrations, while heat accelerates them, and either agent may thus alter one of the waves, causing coincidence and consequent stimulation, or separation by a half or a quarter of a wave and consequent inhibition or restraint.

Spinal Stimulants increase the **functional activity** of the cord. They apparently act much in the same manner as mechanical irritation, or electricity. They seem to increase conductivity through the nerve-cells. Small doses heighten reflex excitability; large doses cause tetanic convulsions; but such convulsions as already indicated also result from large

doses of drugs which exert a sedative or paralysing action, as opium, morphine, and belladonna. Spinal stimulants include strychnine, brucine, and thebaine, as well as nicotine, calabarine, caffeine, absinthe, and ammonia. They are **used in** cases of **general debility,** in paralysis unaccompanied by inflammation, and to rouse sluggish action, as of the bowels.

ACTION OF DRUGS ON NERVES.

PARALYSERS—STIMULANTS—ELECTRICITY.

Nerves may be **acted upon** in various parts of their course; in the **nerve centres** in which they originate; in their **cords** or trunks; or in their **minute endings** distributed in muscles or glands. Motor nerves have their excitability more readily disturbed or destroyed than sensory nerves. Injuries of compound nerves frequently arrest motor function, but leave the sensory function slightly, or only temporarily, impaired. The nerve trunks are much less susceptible than the end plates, and are only acted upon by strong solutions directly applied to them. Many medicines, acting on the terminal nerve fibrils, also act on other parts of the nervous system. It is always, however, important to realise **the order** in which **different parts** are **affected,** inasmuch as the primary action frequently modifies those which may be subsequently produced. Different effects are often caused by the same drug when given in different doses, and many medicines, such as alcohol and ether, first increase and subsequently diminish nervous irritability.

PARALYSERS of **motor nerves** have their most powerful representative in curare, which seems to destroy the conducting power of the minute nerve fibrils by acting on their cement substance at Ranvier's nodes. Numerous other agents also paralyse motor nerves, of which the best known are coniïne, ammonium cyanide, and iodide, and the ammonium iodide compounds of ethyl, methyl, amyl, and phenyl.

Increased excitability of motor nerves is more difficult to measure than paralysis; but, like the latter, it occurs in the nerve-endings, and is produced by aconite, camphor, guanadine, nicotine, pilocarpine, and pyridine, and in warm-blooded animals by physostygmine. Alcohol, ether, and chloroform

applied directly to nerves, first increase and then diminish their irritability. Atropine applied in like manner diminishes irritability of the intra-muscular endings, and afterwards of the trunks (*Brunton*).

Sensory nerves are readily acted upon by many drugs; their local effects are comparatively easy to determine; but when the drug enters the circulation many structures are liable to be affected, and definite results are difficult to obtain. Much trustworthy information, has, however, been got by experiments on frogs, chiefly by ligaturing the sciatic artery of one leg, injecting into another part of the body the drug to be tested, and by pinching, pricking, heat, or electricity, noting the difference in sensation between the poisoned limb and the ligatured unpoisoned limb. By these and other such experiments, it is demonstrated that **nervous sensibility** is **diminished** by aconite, belladonna, and atropine, carbolic acid, chloroform, and chloral, veratrine, with opium and morphine. Such agents are accordingly serviceable in relieving itching and pain. Few sedatives have more notable topical paralysing effect on sensory nerves than hydrocyanic acid. Some local sedatives exert very marked paralysing effects on the terminals of cutaneous nerves, temporarily destroy sensibility, and hence are useful **local anæsthetics.** Amongst these are extreme cold, in the form of ice or freezing mixtures, ether spray, carbolic acid, cocaine, and kawa-resin (p. 49.)

The **irritability** of sensory nerves is **increased** by topical irritants. Aconite, whether applied locally, or carried through the circulation, produces peculiar numbness and tingling of the tongue and lips, and indeed of all parts supplied by the fifth nerve. Veratrine causes similar sensations in the joints and extremities.

Electricity, in the forms of magnetism, galvanism, or faradism, is used in medical, and occasionally in veterinary practice. **Faradism** as a galvanic current momentarily interrupted is most generally employed. Batteries, coils, and appliances for veterinary purposes, are now manufactured by Messrs Arnold, West Smithfield, London. Slight electric currents stimulate both motor and sensory nerves and muscles; more powerful or long continued currents exhaust, paralyse, or tetanise.

Like nux vomica, and other excito - motors, electricity **stimulates depressed nervous action**, controls disordered action, and hence improves impaired nutrition. For strains of muscles and ligaments, after the primary inflammation and effusion are relieved by fomentations and rest, faradism over the seat of injury further removes pain and stiffness. The current of suitable strength, applied for six or eight minutes, and repeated if needful twice daily, frequently benefits, and sometimes removes muscular rheumatism, which is not uncommon in horses, and is also serviceable in chronic articular rheumatism, which has resisted other treatment.

Paralysis depends upon various conditions, functional and molecular, and hence demands very different methods of treatment. Electricity however is often useful alike in diagnosing its exact seat and extent, and also in abating or removing the depressed or disordered conditions on which it depends. Torpidity of the bowels, resulting from imperfect intestinal peristalsis, is sometimes overcome by faradisation. In muscular wasting one electrode is placed over the principal local nerve centre, or nerve of the wasted part; while the other is moved over the shrunk muscles so as to stimulate contractions, and the operation continued for ten or fifteen minutes twice daily. Cases of roaring have thus been successfully treated. One electrode is applied in the angle of the neck in the jugular furrow above the larynx; while the other is moved over the surface of the larynx and down the trachea. Only gentle occasionally interrupted currents are used, are kept up for six or eight minutes, and are repeated twice daily. In cases of asphyxia from poisoning by chloroform or other causes, faradism of the phrenic nerves is sometimes adopted to stimulate the failing or arrested inspiratory movements.

Clonic spasms, represented according to their cause or site by trifling tremors or violent convulsions, are sometimes treated by electricity. The current may be applied to the faulty centre in the brain or spinal cord, to the nerve trunk, the conductivity of which is morbidly affected, or to the local centres which are acting abnormally. Chorea in dogs, especially when of the chronic paralytic type, has been benefited by electric treatment.

When insulated needles are placed in the tissues, and traversed by the electric current, decomposition of the tissues ensues, and this process of **electrolysis** is occasionally employed for the removal of tumors. Cauterisation is sometimes effected by heating a platinum wire by a current, now conveniently derived from one of Faures' portable accumulators.

Electro-therapeutics as applied to the domestic animals deserves more extended practical study. The primary conditions for its rational and safe employment consist in a thorough understanding of the instruments used, and a knowledge of the strength of currents, and their proper distribution to the parts to be influenced.

ACTION OF MEDICINES ON THE EYE.

In the local treatment of the cornea and conjunctiva the fitting **astringents** are mercuric chloride and silver nitrate. Lead salts are unsuitable, as they form an insoluble albuminate, which may cause opacity. Alum and potassium permanganate are undesirable, on account of their tendency to dissolve the cement uniting the corneal fibrilæ. The **antiseptics** generally used are mercuric chloride and boric acid, the latter frequently conjoined with an equal quantity of sodium sulpho-carbolate. The **sedatives** preferred are hydrocyanic acid, morphine, atropine, and cocaine. The sensitiveness of the eye is increased by strychnine. It is diminished, and **local anæsthesia** produced, by cocaine, which, accordingly, is serviceable in some examinations, as well as in operations on the eyes. The lachrymal secretion is increased by such volatile oils as mustard and onion, and by physostygmine. It is diminished by atropine.

The iris is dilated by belladonna, atropine, and homatropine. Such dilators are termed **mydriatics.** The contractors of the iris are termed **myotics,** and are represented by calabar bean, and its active principle, as well as by opium, muscarine, pilocarpine, and thebaine. Anæsthetics first contract, and in full doses, from circulation of venous blood, dilate, the pupil. "From ten to twenty minutes after a solution of atropine has been dropped on the eye, the pupil dilates, and the ciliary

muscle becomes paralysed, so that the accommodation for near objects is no longer possible, and the eye remains focussed for distant objects. When a solution of physostygmine is dropped into the eye, the pupil contracts, and the ciliary muscle becomes spasmodically contracted, so that the eye is accommodated for near objects" (*Brunton*). Alike in both cases, the action is purely local. The dilatation caused by atropine is due to increased action of the dilator, as well as diminished action of the sphincter iridis. Local myotics act in two ways: physostygmine stimulates the muscular fibres of the sphincter iridis; while muscarine, pilocarpine, and nicotine stimulate the peripheral ends of the occulo-motor nerve.

Mydriatics are **used** to allay irritation, inflammation, and pain. In iritis they keep the iris off the surface of the lens, and thus prevent adhesions. Dilating the pupil, they facilitate examination of the edges of the lens for cataract. **Myotics** are **used** alternately with mydriatics to discover the presence of adhesions of the iris, and break them down when present. From their lessening intra-occular tension, they are employed in glaucoma, especially in the earlier stages.

Few observations have been made on the actions of drugs on the senses of hearing, smell, or taste in veterinary patients.

ACTION OF MEDICINES ON RESPIRATION.

ERRHINES AND EXPECTORANTS.

Respiration consists in the alternate enlargement and diminution of the cavity of the chest, whereby air is alternately inspired and expired. These movements, so essential to the life of all the higher animals, are chiefly presided over by a nerve-centre or group of ganglionic cells, situated in the medulla, posterior to the vomiting centre, and extending into the anterior part of the spinal cord. This centre is normally stimulated by venous blood, and inspiratory movements are thence co-ordinated. The diaphragm is drawn back, the intercostals and scaleni muscles raise the ribs, and air rushes into the lungs, distending the elastic walls of the air cells. In ordinary circumstances, almost passively, the chest walls, with little muscular exertion, again contract, and air is expired. Expiratory effort, although

scarcely realised in ordinary breathing, is, however, evoked in coughing and sneezing, as well as in producing vocal sounds. Inspiration and expiration thus alternate, in healthy adult horses at perfect rest, from 12 to 16 times per minute, in cattle about 15 to 20 times, in sheep from 13 to 18 times, and in dogs from 15 to 20 times per minute.

The **respiratory centre** is stimulated by heat, and by strychnine, ammonia, atropine, thebaine, apomorphine, emetine, substances of the digitalis group, with salts of zinc and copper. It is first excited and then depressed by caffeine, nicotine, quinine, and saponine. Its activity is diminished, with consequent slow and shallow respirations, by cold, chloroform, ether, alcohol, opium, physostygmine, and aconite. **The vagus** branches distributed to the lung, and all sensory nerves, when slightly stimulated, are mainly **nerves of inspiration,** and when they are stimulated cause quickened shallower respiration. The **expiratory nerves** are the nasal branches of the fifth, the superior, and inferior laryngeal, and the cutaneous nerves, particularly of the chest and belly. When these are stimulated, the respiratory movements become slower and deeper. "Atropine injected into the jugular vein seems to produce first a slowing of the respiration, due to its paralysing action on the vagus ends, and afterwards a progressive quickening, as more of it is carried out of the lungs into the medulla. Physostygmine, muscarine, and veratrine have an opposite action, quickening the respiration at first, by their stimulating the vagus ends, and afterwards slowing it by their action on the medulla" (*Dr Lauder Brunton*).

Errhines or sternutatories, when applied to the nostrils, **cause irritation, sneezing, and increased secretion.** They include tobacco in a finely divided state, veratrum album, ipecacuanha, euphorbium, and saponine. Errhines although now disused, were formerly prescribed to cause counter-irritation in diseases of the eye and head, and to expel, by inducing sneezing, foreign substances lodged in the nostrils, nasal sinuses, or respiratory passages.

Expectorants help to **remove secretions from the air passages.** The healthy respiratory mucous membrane is moistened and protected by a thin, slightly adhesive solution

of mucin, which is gradually moved outwards by the cilia. Cold applied to the surface of the body, dust and foreign particles, and microbes, as in cases of influenza, readily excite irritation of the respiratory tract, and alter the amount and character of the mucus.

While the irritated membrane is dry and vascular, as in the earlier stages of catarrh and bronchitis, the breathing of **warm, moist air,** diffused from a steam kettle or nose-bag containing a hot mash, beneficially dilates the congested vessels, and promotes secretion. In such cases, and notably in laryngitis, **heat** and **moisture** should also be applied **externally** by means of flannel or woollen waste wrung out of boiling water or oil, covered with thin water-proofing, and kept in place by a properly adjusted hood. Further **counter-irritation** may subsequently be needful. In the dry stage of inflammation of the respiratory membrane, **expectorants** of a **depressant** type, lessening blood-pressure and increasing secretion, are indicated, such as antimonials, alkalies in small doses, ipecacuanha, lobelia, jaborandi, apomorphine, and potassium iodide, which last, moreover, increases and liquifies many other secretions. Frequently in chronic bronchitis, when the respiratory membrane is congested and blood stagnates in the lungs, good results follow the combination of depressant expectorants with such a heart and vascular tonic as digitalis.

When the secretion of the respiratory mucous membrane becomes excessively thick and adhesive, and irritating cough is hence provoked, **stimulating expectorants**, which increase blood-pressure and diminish secretion, are indicated. The most trusted of these are acids, ammonium salts, nux vomica, senega, squill, balsams, terebinthinates, sulphur, sulphur oils, and saccharines. Oil of turpentine in a vaporised state, or the old popular remedy of the fumes of burning tar, prove effectual in moderating vascular congestion and profuse secretion in many cases of bronchitis. The **throat,** when in a **soft, relaxed** state, is generally but the visible indication of a similar condition extending throughout the respiratory tract. The appropriate treatment is a combination of terebine and an acid which may be given as an electuary, and exerts beneficial effects both topically and generally.

Expulsion of the respiratory secretions is produced by increased activity of the cilia, which are believed to be stimulated by ammonia solutions, and by increased activity of the respiratory centre, which, as already stated, is also stimulated, by ammonia salts, as well as by ipecacuanha, belladonna, and senega.

Influenza colds, so common amongst horses, and notoriously catching, probably depend upon **specific germs,** attack sometimes the upper, sometimes the lower air passages, not infrequently also produce gastro-intestinal catarrh, and sometimes extend from one of these sites to others. Occasionally such seizures may be checked or mitigated in their early stages by moistening the parts first affected with **carbolic** or **sulphurous** acid solutions applied in the form of spray gargle or electuary. The like treatment proves beneficial in later stages, by lessening congestion or exerting antiseptic effects. The washing out of the nostrils is conveniently done by an ordinary enema syringe, by an indiarubber ball fixed to a tube, or by Ray's nasal funnel.

The modified respiratory act recognised as **cough** forcibly removes liquid and solid substances present in the air passages. The chief exciters of cough are various afferent branches of the vagus, notably the superior laryngeal, which is distributed to the larynx and trachea, and being an expiratory nerve, gives rise to the loud barking, violent, explosive cough which characterises irritation of the upper air passages. Irritation of the lower air passages, where the nerves are chiefly inspiratory, gives rise to a short, suppressed, hacking cough. Irritation of the pleura, stomach, and liver, reflexly induce cough. Soothing **gargles** and **electuaries,** even if they do not actually reach the seat of irritation, frequently abate cough. Internal organs and their external openings act and react on each other. The throat participates in inflammation of the bronchi or lungs; while conversely its soothed or invigorated condition is usually extended to deeper-seated parts.

Mechanically acting mucilaginous or saccharine substances may be rendered more effectual by combination with **morphine,** which exerts a two-fold action—(1) diminishing irritability

of the respiratory centre; and also (2) diminishing secretion of mucus. This latter result is still more notably effected by **atropine.** The combination of these two alkaloids is hence specially valuable where there is troublesome cough and profuse secretion of mucus. A somewhat different effect is obtained by conjoining morphine and apomorphine, which, with diminished excitability of the respiratory centre, produce increased respiratory secretions, and this combination is hence serviceable where there is cough, and the membrane is dry or coated with thick, sticky mucus.

A comfortable loose box with abundance of pure **fresh air** at a temperature of about 60° Fahr., in several ways benefits the patient suffering with respiratory disease. More perfect aeration of blood is secured, while the cool, pure air, moreover, contracts dilated vessels, combats congestion, and hence will often remove cough, especially when depending upon irritation of the larynx, trachea, or larger bronchi. But while in many stages of respiratory disease the breathing of cool air is grateful and beneficial, draughts and cold must be scrupulously guarded against, and the body and legs of the patient kept comfortably warm with extra covering, in order to promote free circulation throughout the surface vessels, and thus antagonise congestion of the internal organs. Experiments on small healthy animals show that ice applied to the surface of the belly, immediately induces paleness of the respiratory membrane, speedily followed by congestion, and gradually developing venous lividity, accompanied by increased mucous secretion. Removal of the ice and substitution of a hot poultice, gradually restores the parts to their normal state, and this acute congestion and gradual return to health may thus be alternately demonstrated. These effects of cold and heat strikingly illustrate the causation of inflammation of the respiratory organs, and also the effectual manner of relieving them.

Cough depending upon **gastric** derangement, not uncommon in young animals, is often relieved by antacids. Cough resulting from **bronchial filaria,** is abated by the usual soothing remedies, and removed by turpentine drenches, and by inhalation of chlorine or sulphurous acid, diluted with

air, and rendered still more effectual for destruction of the parasites when conjoined with carbolic vapour.

In **dogs** with bronchitis or pneumonia, in whom the breathing is difficult, relief is often obtained by giving an **emetic** of ipecacuanha and squills. Venous congestion is overcome, and the state of the bronchial secretions improved. These good effects may often be maintained by the subsequent use of frequently repeated doses of ammonium carbonate. which is also serviceable when the patient is too weak to justify the use of an emetic. In dogs recovering from acute attacks, or suffering from chronic bronchitis, **cod liver oil** is often useful, possibly on account of its furnishing readily assimilable nourishment for the delicate epithelial cells, and thus preventing their being shed as pus—*(Dr Lauder Brunton).*

ACTION OF MEDICINES ON THE CIRCULATION.

STIMULANTS—TONICS—SEDATIVES.

Many agents act in various ways on one or more portions of the circulatory system. An able authority on the subject—Dr Lauder Brunton—divides them into agents acting on the heart and on the vessels, and again subdivides these two groups into three classes of stimulants, tonics, and sedatives.

HEART STIMULANTS **increase the force and frequency of the pulse** in conditions of depression. The most important are ammonia and its carbonate, alcoholic solutions, ether, chloroform, camphor, oil of turpentine, and other volatile and aromatic oils, with heat and counter-irritants to the præcordium. They exert their effects in somewhat different ways. The alcohol group mainly stimulate the motor ganglia. Guanidine, physostygmine, and camphor are believed to act chiefly on the heart muscle, exciting it to pulsate rythmically. Ammonium liquor, carbonate and spiritus aromaticus, with turpentine and volatile oils, chiefly stimulate the vaso-motor centres. Alcoholic, etherous and ammoniacal solutions, especially when given in tolerably concentrated form, immediately stimulate the mouth, throat, stomach, and other parts with which they

come in contact, and thus their effects are widely reflexed, often anticipating the stimulation resulting from their actual conveyance in the blood stream to the heart and other organs.

Cardiac stimulants are used to counteract failure of the heart's action from shock, physical injury, overwork or depression dependent on disease. Stimulants when acting favourably, produce a more vigorous complete heart-beat—the pulse, previously slow, is accelerated; or if quick, unequal, or weak, it becomes slower, more regular, and stronger. The heart pulsating more quickly, and propelling at each heart-beat a larger volume of blood, arterial or blood-pressure is increased. A combination of two stimulants, acting as indicated in more ways than one, is often more effectual than any single drug. Hence alcohol is frequently conjoined with ether, ammonia, or aromatic volatile oils. Heat used in the form of warm drinks, and also externally, as warm rugs, fomentations, or poultices, is a heart stimulant, especially when the applications are laid over the præcordium.

VASCULAR STIMULANTS **dilate the peripheral vessels,** and thus accelerate the bloodflow through them. They do not increase the action of the vaso-motor centre, nor the contractility of the vessels, but, on the contrary, diminish their contractility and cause their dilatation. Prominent amongst remedies acting in this way are alcoholic solutions, ether, nitrous ether, and ammonium acetate. The alcohol series, combining the two-fold action of stimulating the heart and dilating arterial and capillary vessels, usefully **combat chill, equalise circulation,** and prevent or **relieve congestion.** Horses brought in chilled and exhausted—their skins dry and their coat staring—are frequently saved from congestion and inflammation of internal parts by the timely use of a stimulating drink, the good effects of which are further secured by an extra rug and flannel bandages to the legs. More permanent dilatation of external vessels is effected by frequently repeated doses of nitrous ether and ammonium acetate, with which camphor may also be conjoined. In combating **chronic inflammation,** vascular stimulants are also serviceable, and their operation is further promoted by hot applications, friction, and counter-irritation.

HEART TONICS produce their effects more gradually and

slowly than heart stimulants. Although large doses induce irregular action, repeated moderate doses generally **render the contractions slower, but more regular and stronger.** They consist of digitalis and its alkaloids, casca and its active principle, erythrophlœin, strophanthus hispidus, squills, caffeine, nux vomica, and strychnine. They are chiefly useful where the left ventricle, from weakness caused by **reducing disease** or from **incompetence of** the tricuspid and mitral **valves,** is unable to drive the blood into the aorta. In hard-worked horses compensating hypertrophy gives increased propelling power, and hence sometimes mitigates the results of valvular disease. When **dilatation** occurs, and the mitral valves are insufficient to close the orifice, blood is liable to regurgitate into the left auricle, retarding the blood flow from the lungs, and leading to general venous congestion. Heart tonics, notably digitalis, relieve this condition, by imparting to the contractions the needful regularity and strength; while moreover, by slowing the beats the ventricle is more completely filled. In dilatation of the right side of the heart, usually depending upon serious attacks of influenza, bronchitis, or emphysema, heart tonics are seldom so beneficial as in mitral disease. Where blood-pressure is abnormal, it is usually desirable in vigorous subjects to relieve venous congestion by purgatives or diuretics before even the most cautious use of heart tonics is attempted.

VASCULAR TONICS **cause increased contraction of arterioles and capillaries.** They stimulate the vaso-motor nerves, and thus raise blood-pressure, and also promote outflow and absorption of lymph. The most important are digitalis, iron, and strychnine, with friction of swollen infiltrated parts, equable pressure as of well-applied bandages, and exercise, which secures oxidation and muscular movements, favouring outpouring and removal of lymph and waste products. Vascular tonics are chiefly used to combat **local œdema,** resulting mainly from changes in the walls of the capillaries, and more general dropsy depending upon tardy removal of lymph from the lymph spaces or serous cavities, upon a watery condition of the blood, or upon vaso-motor paralysis. Dropsy resulting, as it often does, from anæmia is appropriately treated by iron salts.

The **inflammatory œdema** or lymphangitis attacking usually the lymph glands and vessels of the hind limbs of the heavier breeds of horses, and occurring chiefly in well-fed, hard-worked animals after a day's rest, is probably connected with imperfect oxidation, the consequent formation of sarcolactic acid, obstruction and congestion of veins, capillaries, and lymph vessels. The resulting acute inflammation is combated by hot fomentations, a smart purgative, and saline diuretics, while the tediously chronic œdema, which is apt to follow, is attacked by friction and other vascular tonics and stimulants.

CARDIAC SEDATIVES **lessen the force and frequency of the heart's action.** For such purposes aconite, veratrum viride, and antimonials are chiefly prescribed. In veterinary patients aconite is most effectual, especially when given in small doses, at intervals of two or three hours. It is chiefly used in antagonising violent **palpitating action** of the heart, or lowering the quick full bounding pulse, and other febrile symptoms of laryngitis, laminitis, acute lymphangitis, and other local inflammations.

VASCULAR SEDATIVES **contract blood vessels,** lessen the flow of blood through them, and hence limit local inflammation, and arrest hæmorrhage. They include digitalis, ergot, lead acetate, opium, and topical application of cold. Ice or refrigerant lotions applied to circumscribed spots contract the capillaries and even considerable arteries, and thus relieve congestion, inflammation, and pain. In like manner, ice, when swallowed, arrests bleeding from the stomach, reflexly checks bleeding from the lungs, and, moreover, acts as a cardiac sedative. When the bleeding vessels cannot be reached, either directly or reflexly, ergotine is injected hypodermically.

REMEDIES ACTING ON THE SURFACE OF THE BODY.

RUBEFACIENTS — VESICANTS — SUPPURANTS — CAUSTICS — SETONS — THE ACTUAL CAUTERY — ASTRINGENTS — DEMULCENTS — EMOLLIENTS.

Irritants, when applied to the skin, stimulate or inflame it, and by reflex action, produce certain remote effects, when they are

termed **counter-irritants.** They relieve or remove congestion, inflammation and pain; and, by stimulating functional activity, promote repair. It is not always easy, however, to explain how these curative results are produced.

Heat and **cold** both relieve tension, and hence pain; but they produce their effects in different ways. Cold reflexly contracts afferent arteries, and hence lessens the quantity of blood going to an inflamed spot. Warmth dilates capillaries adjacent to the seat of inflammation, and hence lessens the current of blood going to it.

A blister applied to the chest walls in a case of pneumonia, develops a considerable amount of skin irritation. The stimulus is conveyed by the afferent nerves to the nervous centres, and thence may be reflected down the vaso-motor nerves, causing the lung and pleural capillaries to dilate, thus diminishing tension and pain. Dr Lauder Brunton mentions that "when cantharides collodium was painted repeatedly over the back of a rabbit for fourteen days, the vessels underneath the skin, and the superficial layers of muscles were congested. The deeper layers of the muscles, the thoracic wall, and even the lung itself, were mnch paler and more anæmic than those of the other side." The blister is thus believed to act much in the same way as a warm poultice does, viz., it dilates the congested or inflamed capillary network. Counter-irritants may occasionally, however, act reflexly, as cold does, and by contracting arterial vessels, relieve congestion, inflammation, and pain. But whether the blister dilates or contracts the capillaries of affected parts, it certainly increases circulation through them, and hence hastens absorption, restores healthy action in swollen glands, effusions in joints, and exostoses, if not of too old standing.

The several classes of irritants used externally differ materially in the intensity and duration of their effects.

RUBEFACIENTS produce **slight redness** and **congestion,** and are represented by ammonia solutions, mustard, iodine, mild preparations of cantharides, arnica, alcohol, ether, and chloroform if prevented evaporating by oiled silk or other means, turpentine and many other volatile oils, with smart friction and moderate heat. The laundress's smoothing-iron heated and pressed

equally over the skin, either bare or covered with brown paper or flannel, proves a useful rubefacient in rheumatism and enlarged joints in delicate young animals. Owing to the colour of the skin and abundance of hair, reddening in veterinary patients is, however, less obvious than in man. **Friction** and **pressure,** as in kneading or shampooing, exert many of the effects of counter-irritants, and, moreover, assist in mechanically emptying over-loaded lymph vessels and veins, and thus relieve the swollen legs and joints of hard-worked horses.

VESICANTS are more active and deep-seated, inflame the true skin, and **raise vesicles or blisters,** which contain a serous fluid consisting of about 78 parts of water, 18 of albumin, with a little fibrin, and 4 of salts. Steam and boiling water rapidly produce a large amount of effusion. Blisters, by whatsoever agent raised, after some days either dry up, or, when the inflammation has been considerable, secrete a muco-purulent fluid, which hardens, protecting the parts until the new skin forms. Cantharides, glacial acetic acid, turpentine, strong ammonia, and boiling water are the vesicants in most common use in veterinary practice.

SUPPURANTS actively inflame the deep-seated cutaneous tissues (especially the orifices of the sweat glands), and **cause pustules** and a purulent discharge. This is the effect of euphorbium, croton oil, tartar emetic, mercury biniodide ointment, and also of cantharides, mustard, and other active vesicants, when applied to the same spot repeatedly or in large quantity.

CAUSTICS **combine with the water and albumin of the tissues,** with which they are brought into contact, and cause the separation of a slough. Those causing extensive sloughing, receive the title of **escharotics.** Caustics are exemplified by the concentrated mineral acids, glacial acetic, carbolic, and chromic acids, concentrated alkalies, antimony chloride, arsenic, bromine, and the soluble salts of the heavy metals.

Caustics, although they lower and destroy the vitality of the tissues immediately attacked, reflexly increase the vitality of surrounding or remote parts. Lightly **used** they repress soft, spongy, and exuberant granulations, and stimulate indolent ulcers. They destroy the virus in poisoned wounds, and pre-

vent its absorption; and for this purpose penetrating fluid caustics are preferable to solid. They expedite and complete the destruction of sloughing textures, alter morbid actions of the skin or of wounds, and excite adhesion in the walls of fistulæ. They are used for opening abscesses and forming issues, and for removing warts and other tumors, especially when so deep-seated and vascular that they cannot be safely extirpated by the knife. When employed for the arrest of hæmorrhage from accidental or surgical wounds, they receive the special title of **styptics.** When thus used, the blood is removed by a piece of lint or a sponge, and the part lightly pressed, so that the blood-vessels may be more readily seen, and the caustic applied to them with precision, and with as little destruction as possible of surrounding textures. A coagulum forms over the bleeding vessels, and the effect of the styptic may be seconded by equable pressure and application of cold. (*See* Astringents and Styptics, pp. 70, 71).

Setons are sometimes substituted for blisters or firing, and are frequently preferred to firing on account of their being less apt to blemish. The seton consists of a piece of tape, cord, or fine twisted wire, and is usually inserted by means of a seton needle. To prevent it slipping out, the ends are tied together or knotted. It is usually ordered to be moved daily; and if severe effects are desired, it is smeared with blistering ointment. Setons act chiefly on the comparatively insensible subcutaneous cellular tissues. They are serviceable in combating chronic inflammation of joints, in relieving the lameness of tedious cases of bone spavin, and in strangles in well-bred horses, where they sometimes appear to prevent that atrophy of the muscles of the larynx known as roaring, and so frequently following strangles. Placed in the dewlap, they have also been much used as preventives for black-leg in calves and young cattle, and for splenic apoplexy in older animals; and the effects ascribed to them may result from their increasing the leucocytes which absorb or destroy the specific bacilli.

An **issue** or **rowel** acts in much the same manner as a seton. A wound is made in the skin with a bistoury or rowel scissors, and kept open by the insertion of a pledget of tow,

lint, or leather, which to increase counter-irritation and discharge, is sometimes smeared with irritant dressings.

Acupuncture is effected by needles three to six inches in length, introduced, especially into fleshy parts, with a rotatory movement.

Aquapuncture, conveniently effected with a hypodermic syringe, introduces water or medicated solutions into soft, painful, or irritable textures, and thus sometimes relieves nervous or rheumatic pain, and imparts vigour to wasting or paralysed muscles. Both are forms of counter-irritation.

The Hot-Iron or Actual Cautery is still much used in veterinary practice as a counter-irritant. It is generally applied at a full red heat, and the higher the temperature the less the pain attending its application. It is employed for some of the purposes of active vesicants, and also of caustics. In diseased joints, tendons, and ligaments, in which it is so often used, it amends by reflex action deep-seated faulty nutrition. It does not, as was once currently believed, form a permanent bandage around the parts; for a short time indeed after the operation, the skin is corrugated and tightened, but it soon resumes its natural elasticity, and does not embrace the subjacent parts more firmly than in health. The firing of healthy limbs, with the popular idea of strengthening and bracing them up, is now deservedly discountenanced; and any benefits apparently accruing from such an operation really result from the rest which it necessitates. In nervous excitable horses, firing occasionally produces irritative fever, especially if several legs are done at the same time. **Dry cupping** is occasionally employed as a derivant or irritant in the human subject, and is equally serviceable in the lower animals.

The uses of counter-irritants.—In influenza, bronchitis, and other depressing disorders of horses, in order to rouse the action of the heart, and avert lung-congestion, rubefacients, such as soap-liniment or mustard paste are sometimes rubbed into the chest, abdomen, or legs, and in a few minutes again washed off. Counter-irritants are in common use in certain stages of inflammation of the joints, as well as of the eyes, air passages, intestines, and their investing membranes. They are more beneficial in laryngitis and bronchitis affecting the larger

tubes, than in broncho-pneumonia or pure pneumonia. In the outset of inflammatory attacks, by reflex action, they lessen hyperæmia, chiefly, as above stated, by stimulating the dilated paralysed capillaries, thus favouring resolution. In more acute stages, when blood-plasma and red and white globules are escaping through the walls of the distended vessels, fomentations and poultices are generally more suitable than irritants. When the urgency of the febrile symptoms has somewhat abated, counter-irritants are, however, again useful in promoting absorption of inflammotory products, and they frequently invigorate enfeebled, over-distended capillaries, and substitute higher formative for lower debased action. Blisters act more powerfully on the skins of horses than of cattle, and require to be used with special caution for dogs, which are apt to bite and rub the blistered parts, and thus induce sloughing. For general purposes in canine practice, iodine is the most useful counter-irritant. The action of turpentine on the skin of horses is peculiar. Applied over a considerable surface, it produces such intense itching irritation that some animals for a short time become much excited, a result the more remarkable as turpentine acts but slightly on the delicate human skin.

Various conditions determine **the choice of a counter-irritant,** and the mode of using it. Promptly to produce general revulsion, as in combating chill, rousing nervous depression, or overcoming such functional disturbance as occasions colic, mustard and other rubefacients are specially indicated. To act more permanently on parts in which nutrition has been more seriously impaired, as in pleurisy or phlebitis, cantharides is the appropriate counter-irritant. Where bone, cartilage, or ligament has been chronically affected, a still more profound and permanent effect results from the use of mercuric biniodide ointment, the hot-iron, or setons.

Before a blister is applied, the skin should be well washed with soap and water, and the hair, when long or thick, removed with a pair of scissors or a razor. The effect may be further hastened and increased by subjecting the part to smart friction, or the action of hot water, and by rubbing the agent well in, taking care to spread it over an amount of surface bearing

some proportion to that diseased. Violent deep-seated action is seldom desirable. Abundant discharges evidencing extensive tissue destruction, are seldom requisite. Better curative results are usually attained by more moderate and continuous effects kept up by repeated applications.

Counter-irritants may generally be applied directly over the inflamed organ, when removal of fluid or inflammatory products is desired; but should seldom be applied very near to extensive acutely inflamed parts, or to tissues immediately continuous with them. An inflamed joint is usually better treated by placing the blister above and around rather than upon the acutely inflamed spot. According to the late Dr Anstie, the irritant, if applied over a posterior branch of the spinal nerve trunk, from which the irritated nerve issues, often produces reflex effects of a beneficial character.

When vitality is low, or the skin irritable, blisters are apt to cause sloughing. When inordinate local irritation has been produced, it may be abated by fomentations, while undue constitutional excitement is removed by diluents, a mash diet, and salines. On the next or second day after a blister has been applied, the part should be dressed with vaseline, oil, glycerine, or sugar-of-lead lotion.

Astringents contract the tissues with which they come in contact, and diminish their secretions. The majority appear to owe their effects to their **coagulating** or **precipitating albumin.** Ergot, however, although a notable astringent, has no coagulant power on albumin, but contracts tissues, in virtue of its diminishing the calibre of the nutrient arterioles.

Astringents include alum, lime, and chalk, salts of the heavier metals, acids, and alcohol, with tannic acid, and such tannin-containing substances as oak-bark and catechu. All caustics used in small quantity, or diluted solution, are astringent. Gallic acid, although not coagulating albumin, has hitherto been included in this list, but recent experiments made by Dr Stockman, in the Pharmacological laboratory of the University of Edinburgh, and reported in the *British Medical Journal* of December 1886, have shown that it has no claim to any special astringent action, nor any effect in lessening, like ergot, the calibre of blood-vessels, either by peripheral or

central action. Like all other acids, although in lesser degree, it possesses the power of diminishing the alkalinity of the blood, and hence increasing its tendency to coagulate. The remote effects of vegetable, probably, indeed, of all astringents, has been over-estimated. So soon as their chemical affinities have been satisfied by union with a base or with albumin, they must evidently lose their power of coagulating or precipitating albumin; and it is therefore difficult to see how they can exert astringent effects, either upon the respiratory or upon the urinary mucous membranes.

Astringents are **used** to diminish excessive, and modify faulty, secretion, and to combat congestion of mucous surfaces. Their efficacy is often well seen in circumscribed inflammation of the conjunctiva or fauces. Solutions of tannin and alum, in spray or gargle, or inhalations of turpentine vapour, mixed with air, arrest the inordinate secretion, and relieve the congestion of sore-throat and bronchitis. Their application in disorders of the digestive organs will receive special notice under that heading (p. 88). As injections and suppositories, they are used in irritable and inflamed conditions of the vagina and uterus. The uterus and rectum, when prolapsed, are washed with astringent antiseptics, in order to diminish their irritability and swelling, and facilitate their safe return. They condense exuberant granulations, lessen and amend the faulty discharges from wounds and ulcers which they usually coat with a protective film of albumin.

STYPTICS are astringents specially used to **arrest effusion of blood** from injured surfaces or vessels. Some, like matico, tow, lint, or pressure, mechanically check blood-flow from superficial vessels; others, like most astringents and caustics, coagulate albumin, and thus plug the leaking vessels; others, like ergot, digitalis, ice, and ether-spray contract capillary vessels, while lead acetate probably acts in a two-fold way, increasing coagulability of the blood, and also contracting arterioles. In serious hæmorrhages, it is further desirable that the patient be kept quiet, and that his food be given cold.

DEMULCENTS **soothe, soften, and ensheathe** parts with which they come into contact, act chiefly mechanically, and closely resemble emollients. They include gums, mucilage, linseed,

cotton-wool and collodion, fullers' earth, starch, treacle, gelatine, albumin, fats, oils, glycerine, and milk. They take the place of the mucous and other natural demulcents, where these are defective or wanting. They **lubricate** or **defend** abraded or irritable parts from external injury, acrid secretions, and poisonous matters. When absorbed, they exert, although in modified degree, remote demulcent effects. They are employed in solution, spray, draught, or enema, to relieve dry, irritable, and inflamed conditions of the skin, respiratory, digestive, and urino-genital membranes.

EMOLLIENTS **soften, soothe, and relax** the parts to which they are applied. They resemble demulcents, and include many of the substances specified in that class; but their most effectual and frequently used representative is moist warmth applied by means of fomentation, poultice, spongio-piline, or by lint, folds of flannel, or of woollen cloths, in which the heat and moisture are retained by covering with waterproofing. (*See* Poultices and Fomentations). Fats, oils, lanolin, vaseline, paraffin, with soap and other liniments, are also emollients. Fatty emollients rubbed into the skin soften and supple it; and when applied with smart and continued friction, they also increase tissue-changes, and hasten removal of deposits. In the form of watery vapour, simple or medicated emollients relieve irritability and congestion of the respiratory mucous membrane. In the form of clysters, they directly soothe the posterior portions of the alimentary tract, and by reflex action their good effects are propagated to adjacent parts. Not only do they reduce tension and relax tissues to which they are immediately applied, but, acting on adjacent vaso-motor centres, they dilate collateral blood-vessels; and mainly in these ways fomentations and poultices relieve irritation and inflammation of the throat, lungs, and other deep-seated organs. In the earlier stages of inflammation they effect resolution; in more advanced stages they promote suppuration; in all stages they relieve heat, tension, pain, and spasm. Although serviceable for softening and cleansing wounds, they are generally unsuitable for those likely to heal by first intention or adhesion.

MEDICINES ACTING ON THE DIGESTIVE SYSTEM.

On the Salivary Glands.—SIALAGOGUES—ANTISIALICS — REFRIGERANTS.

On the Stomach.—ANTACIDS—GASTRIC TONICS—STOMACHICS—BITTERS—EMETICS—ANTI-EMETICS—GASTRIC SEDATIVES.

On the Intestines.—PURGATIVES—CARMINATIVES—INTESTINAL ASTRINGENTS.

On the Liver.—HEPATIC STIMULANTS—CHOLAGOGUES—HEPATIC DEPRESSANTS.

On the Pancreas and Spleen.

On Worms.—ANTHELMINTICS—VERMICIDES—VERMIFUGES.

SIALAGOGUES are drugs which **increase the secretion of saliva.** This alkaline fluid comes from the secreting glandular cells which are fed from adjacent lymph spaces, and these in their turn are replenished with fresh materials from the blood-vessels of the glands. The process of salivation is regulated by a **nerve-centre** in the medulla, and subsidiary nerve-centres in the several glands. By food or other substances moved in the mouth, by irritation of the stomach, or even of the eyes or nostrils, stimulation is conveyed by different nerves to these ganglia, and reflexly salivation ensues. In this way the presence of food in the mouth, and the movements of the jaws naturally provoke salivation. In like manner, through different nerves distributed within the mouth, acids, alkalies, ethers, mustard, ginger, and other pungent substances reflexly increase secretion of saliva. Tartar-emetic and other nauseants exert similar effects reflexly by acting on the stomach. Another group of sialagogues, consisting of jaborandi, Calabar bean, and their alkaloids, with muscarine and nicotine, produce salivation when injected into the blood, stimulate the peripheral ends of the secreting nerves within the glands, and are termed **specific sialagogues.** Another group, such as mercury, tobacco, and potassium iodide induce their effects, partly by acting reflexly on the membrane of the mouth, and partly by absorption and stimulation of the secreting nerves.

The saliva and bucal secretions moisten the mouth and

fauces, and hence facilitate chewing and swallowing, and lessen or prevent thirst. The ptyalin of the saliva moreover helps the solution of starch, and the alkaline fluid, when swallowed, promotes secretion of the acid gastric juice, and thus further assists digestion.

The salivary secretion is lessened by various medicines termed **anti-sialics.** Borax and potassium chlorate frequently remove the faulty irritable conditions of the mucous membrane, which lead to over-secretion. Opium and morphine diminish irritability of the nerve-centres, while atropine is the most effective paralyser of the peripheral endings of secreting nerves.

Refrigerants are agents which **allay thirst,** and **give a sensation of coolness. Thirst** is **locally manifested** by dryness of the mouth and fauces, and is believed to be under the special cognisance of a ganglia or thirst-centre, stated to be situated in the occipital lobes of the brain. Thirst is quenched by washing out the mouth with water, or lubricating the dry throat with bland mucilaginous fluids, sucking portions of ice, which horses with sore throats soon learn to do, or swallowing slowly slightly acidulated drinks, which, by stimulating secretion of saliva, moisten the parched membranes. But thirst also depends upon a **deficiency of fluid** in the body, or on the excess of soluble or saline substances in the blood—conditions which are remedied by ingestion of water or other diluents. The extreme thirst which occurs in horses in **polyuria,** or diabetes insipidus, is best controlled by the combination of iodine and opium, the former probably exerting its antiseptic effect, the latter perhaps lessening excitability of the thirst-centre.

ACTION OF DRUGS ON THE STOMACH.

The stomach performs three important functions—(1) it secretes gastric juice, which dissolves the proteids of the food, and thus secures their absorption and assimilation; (2) its churning movements reduce the food, and mix it with the solvent juices; (3) the products of digestion are absorbed, although not so rapidly as from the small intestines.

The stomach of **the horse** is small, relatively to his size;

the cardiac portion is lined with stratified epithelium, and is not available either for secretion of gastric juice or for absorption. The pyloric portion, which occupies about one-half of the viscus, is the active digestive part, and is lined with soft vascular vilous membrane, in which lie the gastric and lenticular follicles. These anatomical conditions retard and limit gastric absorption in horses, and lessen their susceptibility to the action of most medicines administered by the stomach. In **ruminants,** the first three compartments of the subdivided stomach are lined with cuticular mucous membrane, are chiefly occupied in the reception, maceration, and subdivision of the bulky fibrous herbage, which constitutes their principal diet. This thick epithelial covering, and the amount of food always lodged in these three stomachs, explain the tardy action of many medicines administered to runimants, and their taking with impunity large doses of irritants. The fourth stomach is lined with vascular velvet-like mucous-membrane, and secretes the gastric juice, while from its walls absorption takes place. The stomach and digestive organs of the **dog** and **hog** nearly resemble those of man, and are acted on in much the same way by most drugs.

Secretion of gastric juice is stimulated by gentle mechanical and chemical irritation, by introduction of suitable food into the stomach, by the swallowing of the alkaline saliva, and by administration of dilute alkalies, alcohol, and ether. When **indigestion** occurs from presumed insufficiency of the gastric juice, two modes of treatment are available.—(1.) Dilute acids and a little spirit are given to stimulate secretion; but (2.) where, from reducing disease or other causes, the stomach is enfeebled, a substitute for the gastric juice should be given in the form of diluted mineral acid, conjoined, where the food is albuminous, with pepsin. Still a third method is adopted, namely, furnishing food of a more digestible kind, or in a more digestible form. With this object, in the diet of horses, well-prepared mashes are substituted for dry corn and hard fibrous hay; while young calves or foals, with whom undiluted milk disagrees, should have it mixed with water, or better still, with linseed tea, in order that the tough intractible curd may be more easily broken down. The combination of **acids and**

bitters have long been used in dyspepsia, the good effects of the latter being believed to result from their stimulating the movements of the stomach, and from their action on the liver. When tardy and insufficient, the cardiac movements may also be stimulated by nux-vomica and strychnine.

The conditions promoting **absorption from the stomach** are not accurately known. They are intimately connected with the state of the liver and intestines. A dose of physic in all animals notably improves the faulty appetite and removes dyspepsia. The condition of the nervous system probably also affects absorption from the stomach. Professor Bouley found that when the vagi in a horse were divided, strychnine could be administered in full lethal doses without injurious effect. This result appeared to depend upon the movements of the stomach walls being diminished, whereby its contents were only slowly passed into the more rapidly absorbing intestine, and excretion of the poison accordingly proceeded as rapidly as its absorption.

Antacids. Certain forms of dyspepsia depend upon, or are aggravated by, undue gastro-intestinal acidity, which is counteracted by **Antacids.** These comprise the alkalies, potash, soda, and ammonia; the alkaline earths, lime and magnesia; the carbonates and bicarbonates of these bases, and the neutral salts they form with vegetable acids, which are converted into carbonates in their passage through the body. As an antacid, the volatile ammonia is less permanent than the fixed alkalies. Potash and its salts are more active than soda and its corresponding salts. Lime salts, being soothing and astringent, are indicated in diarrhœa; magnesia salts, being laxative, are appropriate where acidity concurs with torpidity of the bowels. Lithium carbonate, present in Baden-Baden and Bath mineral waters, is prized in human medicine as a solvent of urinary calculi and deposits.

Horses fed irregularly or too closely restricted to dry food frequently suffer from gastric acidity, instinctively lick the limewashed walls of their stables, or eat earth, and are usually promptly relieved by antacids and suitable feeding. Calves carelessly managed manifest the same disposition to allay their discomfort by eating earthy matters. Antacids given before

meals excite gastric secretion, given after meals they neutralise gastric and intestinal acidity. After producing a local and direct effect on the digestive organs, they undergo absorption, and produce remote antacid effects on the blood and urine.

GASTRIC TONICS, sometimes called stomachics, **aid gastric digestion,** and **increases** the **appetite.** Such results occur when in experiments the stomach walls are gently irritated, and are also produced by small doses of **mild stimulants** and **bitters.** In certain conditions of gastric irritation, tonics and stimulants are, however unsuitable, and small doses of mineral acids, or of gastric sedatives, such as bismuth or prussic acid, are prescribed.

EMETICS are agents which **cause vomiting.** This is effected by firm compression of the stomach between the diaphragm and the abdominal muscles, and by the simultaneous contraction of the longitudinal fibres which pass from the œsophagus round the gastric walls. When the stomach is thus compressed from behind, and drawn forward, the familiar spasmodic movements of retching result. When, concurrently however with these movements, the cardiac orifice is dilated, the contents of the stomach are thrown up, and vomiting occurs. Dr Lauder Brunton, in the *Practitioner* for December 1874, thus describes **the phenomena of vomiting**:—"Uneasiness is felt; the inspirations become deeper; several swallowing movements are made, which sometimes carry down sufficient air to distend the stomach moderately. After several deep inspirations, there suddenly comes one which is deeper still. Then, instead of this being followed by expiration, the glottis shuts to prevent the escape of air; the diaphragm again contracts still more deeply into the abdomen, and pulling the ribs together, the abdominal muscles forcibly contract; the left half of the stomach is drawn upwards, and the cul-de-sac flattened out; the cardiac orifice dilates, and the contents of the stomach are forcibly expelled. The pylorus remains firmly contracted, and allows but little escape into the intestines."

The movements of vomiting are modified respiratory and ruminating actions, and are presided over by **nerve-centres** in the medulla. The ganglia regulating respiration and vomiting lie close together. Certain cells probably take part in both

actions, and are acted upon by the same agents. "Emetics usually quicken the respiration considerably before they produce vomiting, and, if injected into the veins, they not only quicken the respiration, but prevent the condition of apnœa being produced by vigorous artificial respiration. On the other hand, the desire to vomit may be lessened, to some extent, by taking frequent and deep inspirations, and narcotics which diminish the excitability of the respiratory centre also lessen the tendency to vomit" (*Brunton*).

That the vomiting centre, rather than the stomach itself, is the prime factor in the production of emesis, is evident from Majendie's famous experiment of removing the stomach of a dog, attaching to the severed œsophagus a pig's bladder filled with fluid, which, when tartar emetic was injected into the veins, was compressed between the abdominal muscles and the diaphragm, and emptied of its contents by vomiting.

When the fauces of men, dogs, or other animals which vomit readily are tickled with a feather, or when the interior of the stomach is irritated mechanically, or by a solution of mustard, the stimulus is conveyed by afferent nerves to the vomiting centre by which the special motor impulses are correlated. Many other parts of the body, through their afferent nerves, have communication with the vomiting centre, and hence vomiting is produced, not only by irritation of the fauces and stomach, but by irritation of the brain, lungs, liver and gall ducts, the intestines, kidneys, and bladder, sometimes even by pain or injury of the extremities.

Dogs, cats, and pigs vomit as readily as men. Indeed, in dogs, vomiting is induced by most disagreeably-tasted, nauseous, or acrid substances, and sometimes is brought on purposely by eating Triticum repens and other emetic grasses which instinct readily enables them to discover. But **horses, ruminants,** rabbits, and guinea-pigs **rarely** if ever **vomit,** and are insensible to the action of powerful emetics. In horses emesis only occurs from extreme distension and spasm of the stomach, from dilatation of the lower part of the gullet, from rupture of the intestines, and from the action of large doses of aconite, which, however, induce retching and discharge of excessive secretion of saliva rather than true vomiting. The

insusceptibility of horses to the action of emetics, is due apparently to some undiscovered peculiarity of the nervous mechanism concerned in vomition in most other animals. The horse's inability to regurgitate matters from the stomach, even when attempts to vomit are excited, depends upon several conditions—on the smallness of the stomach, which prevents it, even when tolerably full, from being grasped and squeezed between the abdominal muscles and the diaphragm; on the strong horse-shoe-like band of fibres which guards the cardiac orifice; and on the greater length of that portion of the œsophagus between the diaphragm and stomach, which folds on itself, and thus more securely obstructs the cardiac orifice when the tube, under the influence of emetics, is shortened by the contraction of its longitudinal fibres. The contents of the horse's stomach, even if discharged upwards, owing to the position and length of the velum palati, would pass out by the nostrils, and not by the mouth. As cattle naturally ruminate, it might be supposed that they might also readily perform the analagous act of vomiting; but the substances which cause emesis in other animals have no such effect on cattle or sheep. This mainly depends upon the large size of the subdivided stomach, which cannot be grasped and compressed between the abdominal walls and diaphragm. In horses and ruminants, the arrangement of the digestive organs thus practically preventing vomiting, the vomiting centre would not be required; if it ever existed amongst earlier races, it has become dwarfed or entirely disappeared, as seems evident from the notable tolerance which these animals have of tartar emetic. Professor M'Fadyean suggests that in ruminants the power to vomit has perhaps been merged into the habit of rumination.

Emetics are divisible into two classes:—

(1.) Those which mainly act **locally** on the pharynx or stomach, such as copious draughts of luke-warm water, bitter infusions, solutions of salt, mustard, alum, and ammonium carbonate, with copper and zinc sulphates.

(2.) Those which act **generally** through the circulation, such as tartar emetic, ipecacuanha, and emetine, apomorphine, senega, and squill. Muscarine and digitalis are general emetics, although not used medicinally.

Emetics acting locally stimulate the vomiting centre reflexly from the stomach. Those acting generally may be carried direct to the vomiting centre, but many are also attracted to the stomach, are excreted through the gastric mucous membrane, and thus, in part at any rate, act reflexly. Tartar emetic injected into the blood is believed thus to act in both ways. The effects of local emetics are not of long duration, ceasing usually when the cause of irritation is expelled, and causing little depression. The effects of general emetics are of longer duration, and are followed by more nausea, depression, and increased secretion of saliva, sweat, and mucus, alike from the digestive and respiratory tracts.

Emetics **are used** in dogs and pigs for removing from the stomach foreign bodies, acrid, irritating, undigested food, and poisons. Where prompt and effectual results are desired, as in cases of poisoning, copper and zinc sulphates are most suitable. By relaxing the longitudinal fibres of the gullet, and exciting anti-peristaltic movements, they are also serviceable in expelling obstructions from the fauces and upper part of the œsophagus. They expel bile from the liver, gall ducts, and gall bladder, and force inspissated mucus and small gall stones into the intestine, thus relieving jaundice resulting from obstruction. By clearing out both the stomach and biliary system, they remove biliousness, and, used at the outset, they thus mitigate distemper, and other febrile attacks, and arrest epileptic seizures. In animals which vomit so easily as the dog, it is better that irritants lodged in the anterior parts of the digestive tube, or circulating in the gastro-hepatic system, should be promptly got rid of by the mouth, rather than make the longer and more tedious route through the intestines, running risk of absorption, and thus probably doing further mischief. By stimulating the respiratory as well as the vomiting centre, they promote secretion and expectoration in the dry stage of catarrh and bronchitis, and sometimes in congestive as well as spasmodic asthma. In respiratory disorders, ipecacuanha and squill are often conjoined, and, where there is cardiac depression, ammonium carbonate is prescribed, alone or in combination. Relaxing muscular fibre, they were wont to be given to assist in the reduction of dislocations, but for such purposes anæsthetics are

greatly more effectual. Their paralysing effect on muscular fibre explains why emetics in excessive doses often fail to cause vomiting.

Emetics are **contra-indicated** in gastric inflammation, cerebral congestion, and hæmorrhagic conditions, and require cautious use in pregnancy and hernia.

A safe and **convenient emetic** for a medium-sized dog consists of a teaspoonful each of common salt and mustard dissolved in a tea-cup of tepid water. More prompt and certain effects are produced by two or three grains of copper or zinc sulphate dissolved in a couple of ounces of warm water, rolled in a piece of meat, or mixed with other food. More continued depression follows the administration of three grains tartar emetic and ten grains ipecacuanha given dissolved in three or four ounces of tepid water. Apomorphine is one of the most prompt and certain of emetics, acts by whatever channel it enters the body, and produces full effects on dogs in doses of one-fifth to one-tenth of a grain.

To **check vomiting,** which occasionally proves troublesome in dogs, three methods of cure are indicated—(1) The removal, by appropriate means, of the irritation of the fauces, bronchi, stomach, or other part which excites the reflex act; (2) Lessening irritability of the gastric nerves by the swallowing of small pieces of ice, by icing all food, and administering hydrocyanic acid and morphine; (3) Quieting over-activity of the irritable vomiting centre by morphine, atropine, chloral, or potassium bromide.

ACTION OF DRUGS ON THE INTESTINES.

PURGATIVES—CARMINATIVES—INTESTINAL ASTRINGENTS.

Purgatives or **Cathartics** **cause intestinal evacuations** in one or more of these three ways:—(1.) By accelerating the peristaltic movements of the bowels; (2.) By increasing secretion from the intestinal membranes; (3.) By limiting absorption of the intestinal fluids.

Intestinal movements are dependent on the ganglia of Auerbach's plexus, situated between the outer longitudinal and inner circular layers of muscle. **Secretion** is believed to be influenced by Meissner's plexus, lying in the sub-mucous

coat; but these ganglia, immediately regulating intestinal movements and secretions, are controlled by cerebro-spinal centres and nerves, notably by the vagi, which, when irritated, cause increased peristalsis, and by the splanchnics, which, although containing both stimulant and inhibitory fibres, generally diminish intestinal movements. When all the cerebro-spinal nerves going into a portion of intestine are divided, copious fluid discharges pour into the intestine; but Dr Lauder Brunton and Dr Pye Smith, who thoroughly investigated the subject, found that the nerves which specially restrain secretion are the inferior ganglia of the solar plexus, with the superior mesenteric offshoot from them. The blood supply of the intestine is mainly regulated by the splanchnics, and also by the lumbar portion of the cord.

Purgatives vary much in the **degree** and **nature** of their action, and are frequently classified as follows:—

Laxatives or **aperients,** such as small doses of oil, magnesia, sulphur and treacle, with fruits, roots, and green vegetable food.

Simple purgatives, such as full doses of oils, aloes, various species of rhamnus, produce more copious, softened, or fluid evacuations, and act mainly by increasing the intestinal secretions.

Drastic purgatives, such as croton oil, colocynth, elaterium, gamboge, and podophyllin, greatly increase both peristalsis and secretion; violently stimulate intestinal contractions, causing more or less pain; promptly produce copious, frequent fluid discharges; and in large doses may cause serious intestinal irritation and inflammation.

Hydragogues, such as elaterium, gamboge, croton oil, and other drastic cathartics, with large doses of the more active salines, excite copious intestinal secretions.

Cholagogue purgatives, such as mercurial preparations, aloes, podophyllin, and euonymin, remove bile, and will receive special notice later (p. 91).

Saline purgatives consist of neutral salts of the alkalies and alkaline earths, such as magnesium sulphate and citrate, sodium sulphate, potassium tartrate, and bitartrate.

The salines have been specially investigated by Dr Matthew Hay (*Journal of Anatomy and Physiology*, vol. xiv.) His admirable

observations show that, without causing much increased peristalsis, they notably increase the alimentary secretions, and impede absorption. They do so chiefly in virtue of their specific irritant and bitter properties. They act especially on the small intestines, but only slightly increase the secretion of bile or pancreatic fluid. When the accumulated fluid mechanically distends and stimulates the intestine, some extra peristalsis is excited. Saline solutions, weaker than 10 per cent., provoke little or no secretion in the stomach, and not much in the bowels. A 20 per cent. solution given to dogs or men rapidly increases secretion, which reaches its maximum in one to one and a-half hours. But the larger the amount of fluid given with the saline, the more prompt will be the purgation. Magnesium and sodium sulphates are in part decomposed, their acid being more rapidly absorbed than their base. No increase of secretion is produced, as was formerly taught, by the acid or salt, when, after absorption, it is excreted into the intestine; nor do either of these salines excite intestinal secretion when injected into the blood, or subcutaneously. More inorganic than organic matters are removed by salines from the blood. The amount of fluid secreted has been measured by Dr Lauder Brunton, who experimented on cats with concentrated solutions of Epsom salt tied into a loop of intestine. In four hours he found that from 42 to 56 minims of serous fluid were outpoured for every inch of surface acted on. In cattle or horses upwards of 12 square feet of intestine must often be directly stimulated by even a moderate dose of physic. A secretion of 50 minims to the inch would give a discharge of 9 pints of fluid. Such considerations illustrate the depurative and febrifuge effects of an active cathartic.

The **intestines of the horse** are voluminous, presenting about 90 square feet of vascular mucous membrane. Purgatives and other irritants hence require to be used with much caution. For a day previous to the exhibition of a purgative, the animal, if possible, should be restricted to mash diet or green food. The dose should be moderate, and its effect may be accelerated and increased by administering it while the animal is fasting, by occasional gentle exercise, until it begins to operate, and by the repeated use of clysters. This last

auxiliary, when properly employed with sufficient perseverance, is indeed so effectual in promoting the action of the bowels, that one of the most successful of army veterinarians was wont to trust almost entirely to its use, seldom giving, except in extraordinary cases, any purgative medicine whatever. In serious, obstinate impaction of the large intestines, a flexible tube, six feet long, should be screwed on to a Reid's pump, and copious enemata introduced into the colon (*see* Enemata). For horses, aloes is the best cathartic. Linseed and castor oils are tolerably good, but less certain; while croton is much too drastic, unless in small amount, and largely mixed with some bland oil. Salines in carthatic doses are irregular, and sometimes act with unexpected violence. Senna, colocynth, buckthorn, and other drugs used as purgatives for men and dogs, have little effect on horses.

With a warm mash the previous night, and subsequent abstinence from solid food, a moderate dose of aloes given in the morning, assisted by further mashes and occasional draughts of tepid water, purges most horses in ten or twelve hours. Without this desirable preliminary preparation, purgation seldom occurs within eighteen or twenty hours. In acute febrile cases absorption is usually tardy, and is helped by combination with some sedative, as aconite, calomel, or tartar emetic. A horse should never have purgative medicine when his strength is reduced and his pulse small and weak, when in the advanced stages of inflammatory disease of the air-passages, never without extreme caution in influenza and other debilitating epizootics, and seldom when the bowels themselves are congested or inflamed. I have known horses affected by bronchitis die from superpurgation, induced by three and four drachms of aloes; and similar susceptibility to the action of moderate doses is also observable in influenza, purpura hæmorrhagica, and laminitis.

In **cattle** and **sheep** the magnitude of the *quadrisected* stomach, the large amount of food which it always contains, the relatively small size of the true digestive compartment, and, compared with the horse, the shorter length and smaller capacity of the intestines, explain the tardy uncertain action of purgatives and some other drugs. For these ruminants saline

cathartics are preferable, and their action is materially hastened by encouraging the drinking of water, rendered palatable by sweetening it with treacle. In obstinate constipation, or torpidity of the bowels, gamboge, croton, and calomel are often useful. Purgation may usually be produced among cattle in from twelve to sixteen hours; but cases frequently occur where, in spite of all treatment, the bowels remain unmoved for several days. The best purgatives for **sheep** are common and Epsom salts and castor oil, in doses of about one-fourth of those given to cattle. Calomel and croton are apt to act too violently. As sheep drink sparingly, their medicine should be given with a liberal quantity of fluid.

The dog, on account of his small stomach and short alimentary tube, and the concentrated nature of his food, is peculiarly susceptible to the action of purgatives. Jalap, with a little calomel, or a mixture of equal parts of linseed and castor oils, is most generally approved of, and usually operate in from five to eight hours. Aloes acts more slowly and uncertainly, while saline medicines are apt to cause vomiting, or, if retained, to purge with undue violence. Indeed, any purgatives, when unpalatable, acrid, nauseous, or bulky, are apt to be expelled by vomiting.

Pigs are acted on by cathartics much in the same way as men and dogs, and are best physicked by administering, from a shallow spoon or bottle, three or four ounces of Epsom salt dissolved in water, or a like amount of linseed or castor oil. During the operation they must be held by the ears by an assistant, whose grip will not be released by the squealing of the patient.

The uses of purgatives are numerous. No medicines are applied to so many important purposes.

(1.) They remove from the alimentary canal undigested food, fæces, bile, some poisons, and worms. Sweeping away partially digested food, they diminish the amount of blood-making materials, and thus diminish plethora and obesity. In horses fully two-thirds of the fluid ingesta, under ordinary circumstances, are removed by the bowels, and this large amount is greatly increased when physic is given. They remove noxious gases and fluids, ptomaïnes, and other intestinal toxic matters

which are the direct causes of dyspepsia, colic, and diarrhœa; and which, moreover, secondarily or reflexly, produce nervous depression, skin irritation, and other local hyperæsthesias.

Constipation is usually dependent in great part on deficient peristalsis, and hence when of frequent occurrence, is often advantageously combated by conjoining a little nux vomica with the cathartic. Horses too closely restricted to dry food frequently have habitual constipation, and in such cases the diet should be varied with an occasional mash, a little linseed cake or green food, while water *ad libitum* should be allowed at least four times daily. The bulky and comparatively indigestible nature of the horse's food induces copious alrine evacuations, which are normally evacuated at intervals of four or five hours. Impaired intestinal action or obstruction, hindering or arresting these frequent evacuations, causes more serious and rapidly fatal results in horses than in men, dogs, or ruminants, in whom the bowels naturally act less frequently, and sometimes remain unmoved for several days without causing much harm. Constipation troublesome in dogs that are in the house, or kept on the chain, is best treated with a dose of oil, and prevented by attention to diet.

Diarrhœa, at its outset, is usually most effectually removed by a doze of oil, given with a little laudanum—a prescription which removes the cause of irritation, and quiets the excessive peristalsis. When diarrhœa depends, as it sometimes also does, on diminished absorption of fluid matters from the bowels, a little ether proves serviceable in quickening absorption.

Removal of bile will be specially referred to, under Cholagogues (p. 91), of worms, under Anthelmintics (p. 92).

(2.) Purgatives, notably salines, or hydragogues, shortly determine an abundant **outpouring of the fluid parts of the blood** into the intestine, and thus purge the blood of waste products., relieving febrile attacks, and lowering blood-pressure.

The blood thus left in a state of concentration, speedily recuperates itself, absorbs water and lymph from the tissues, thus relieving œdema, dropsies, and lymphangitis. To secure this special action in its fuller degree, such salines as Epsom salt and alkaline tartrates are specially effective, and their efficacy is increased when they are prescribed in tolerably

concentrated form, and given when there is comparatively little fluid in the alimentary canal. When the catharsis, caused by a saline, has almost ceased, another concentration of the blood occurs, slighter, but of longer duration than the first, and which has also an influence in relieving dropsies and other complaints.

(3.) Purgatives lower the **fever temperature,** but how this effect is produced is not satisfactorily known. For such purposes salines are specially useful. They diminish the force of the circulation, and may in this way lessen the production of heat, and moreover hasten removal from the body of waste or other deleterious matters, which are a frequent cause of increased temperature. In animals in health purgatives do not, however, produce any appreciable lowering of temperature. (*See* Antipyretics, p. 101).

Carminatives are agents which **assist the expulsion of gases** from the stomach and intestines. These gases are chiefly air, nitrogen, from which the oxygen has been absorbed by the stomach-walls, and carbonic acid which is thence excreted, both processes occurring in much the same manner as in respiration within the lungs, but in greatly limited degree. When digestion is in any way interfered with, the contents of the stomach are liable to undergo excessive or irregular **fermentation,** giving rise to large quantities of carbonic acid and hydrogen, which unite with sulphur, sometimes derived from the food, sometimes from the bile, and produce the noisome sulphuretted hydrogen. Formation of these gases is favoured by accumulation of mucus on the walls of the stomach, or by venous congestion of the organ, both of which conditions interfere with the natural absorption of oxygen and excretion of carbonic acid. These gases cause uncomfortable distension, and often provoke spasm and pain. (*See* Antispasmodics, p. 45).

Carminatives are closely **allied to antispasmodics,** and include the aromatic oils of the umbelliferæ and labiatæ and other orders, with ginger, mustard, and peppers, alcohol, ethers, and chloroform. Carbonic acid gas is neutralised by ammonia preparations, sulphuretted and carburetted hydrogen, by solutions of chlorine or lime-chloride.

They are **used** to remove flatulence, spasm, and pain, whether

resulting from direct intestinal irritants, or, secondarily, from chill or other causes. Their effects mainly depend upon their controlling irregular peristalsis. They stimulate contraction of the distended stomach, and thus promote escape of gas, either by the cardiac or pyloric sphincters. Regulating, in like manner, intestinal peristalsis, they displace and expel gases from other parts of the canal, and are also usefully conjoined with purgatives. In cattle, owing to the large amount of food in the first stomachs, it is sometimes difficult to remove accumulations of gas, either by carminatives, or antispasmodics, the use of a gag fixed into the mouth, which frequently reflexly provokes relaxation of the cardiac sphincter, or even by introduction of the probang. Where these means fail, and distension is so great as to interfere with breathing or circulation, it is necessary to remove the gas by an opening made into the rumen, either with the trochar and canula, or with a tolerably large knife. In serious distension, threatening rupture of the large intestines, in horses, the gas is occasionally liberated by puncture of the cœcum or colon with a small long trochar and canula. In the maize-growing States of America, horses and mules greedily eating the green Indian corn sometimes have enormous tympanites, which, defying other treatment, is sometimes thus successfully relieved by operation.

Intestinal Astringents diminish excessive or unduly fluid intestinal evacuations. They are specially used to antagonise various forms of **diarrhœa.** Some, like opium and chloral, lessen the excessive peristalsis on which diarrhœa generally in great part depends. Some, like antacids, neutralise acids which provoke both peristalsis and increased secretion. Some, like creasote, check fermentation and putrefaction, and thus arrest formation of irritants. Others like catechu and tannin-containing substances, coagulate albumin, and consequently dry up both discharge of mucus and of blood. Others, like copper and iron sulphates, usefully conjoin antiseptic and astringent actions. Coto-bark and its alkaloids, although devoid of astringency, exert antiseptic effects, and besides by increasing absorption, remove superfluous fluid from the intestines. Mineral acids and metallic salts are specially indicated when the mucous membranes are relaxed and flabby.

Dr Lauder Brunton and Dr Pye Smith made a series of experiments with various agents, with the view of discovering any which would arrest the copious secretions of cholera. Into isolated loops of intestine magnesium sulphate was injected, while the drug to be experimented upon, was either introduced along with the saline or injected into the veins. "Sulphate of atropine, iodide of methyl-atropine, chloral-hydrate, emetine, morphine, sulphate of quinine, tannin, and sulphate of zinc, were all tried locally, with negative results. Chloral and morphine injected subcutaneously, also gave negative results."—(*Report to the British Association*, 1874.) The conclusion arrived at was that most cases of diarrhœa, whether continuous or alternated with constipation, were best checked by castor-oil, administered with a few drops of opium tincture. Where the diarrhœa still persists, opium in moderate doses is given. Where active peristalsis occurs after eating, drinking, or the excitement of quick work, as in some nervous horses and dogs, liquor arsenicalis is prescribed. Undue relaxation of the bowels, occurring in irritable horses during active work, is mitigated by careful attention to diet, by using the best food in digestible form, allowing water in small quantity at a time, but frequently, and withholding water for several hours previous to putting the animal to quick work.

ACTION OF MEDICINES ON THE LIVER.

HEPATIC STIMULANTS—HEPATIC DEPRESSANTS—CHOLAGOGUES.

The liver is the largest gland in the body. It not only secretes and excretes bile, but part of the bile, mingled with the food materials, is again taken up from the intestine and again excreted, and this circulation through the liver and back to the intestine is accomplished within five minutes. The liver, moreover, acts upon peptones, and probably upon ptomaïnes and waste products (which, accumulating in the blood and tissues, prove injurious, and indeed poisonous), and forms them into sugar and glycogen, which are stored, as it were, "in a coal-bunker," as Dr Lauder Brunton aptly puts it, for the production of heat and muscular energy. This important power of the liver to destroy

poisons, elaborated in the vital processes or introduced from without, is illustrated in Lautenbach's experiments. One-twentieth of a drop of nicotine does not kill a frog, but half that dose suffices when the liver has been removed. These and other observations demonstrate that the blood, recruited by the materials from the intestinal canal, in passing through the capillaries of the liver, has various injurious waste products modified and, along with the antiseptic bile, excreted into the intestine, and thence got rid of.

The effects of various medicines upon the liver have been chiefly ascertained by Röhrig, Rutherford, and Vignel, who curarised fasting dogs, ligatured the common bile duct, and inserted a canula through which the bile secreted was discharged, and collected. Numerous drugs were experimented on, usually by injection into the duodenum. As food increases the secretion of bile, the experiments were made on fasting animals. These experiments demonstrate that medicines acting upon the liver are divisible into three classes:—

(1.) Hepatic Stimulants **increase** the **functional activity** of the organ and the formation of bile, and are represented by dilute nitro-hydrochloric acid, sodium phosphate, salicylate, and benzoate, corrosive sublimate, podophyllin, euonymin, colocynth, colchicin, and ipecacuanha. Some of these drugs augment the quantity of bile without altering its quality; others, like sodium salicylate, increase the quantity and fluidity; others, such as toluylendiamine, increase the solid parts, rendering it so viscid that it cannot readily pass through the bile ducts, and hence becomes reabsorbed and produces jaundice. Podophyllin is a powerful hepatic stimulant, in small doses; but loses this effect when given in larger doses, in which it causes purgation; and similar results occur when other hepatic stimulants are given in such doses as actively to move the bowels. Many aromatic bitters slightly increase bile secretion.

(2.) Hepatic Depressants **diminish the quantity of bile** secreted by the liver. Professor Rutherford found that calomel, castor oil, gamboge, and magnesium sulphate lessened the secretion probably by lowering blood-pressure in the liver; while these and other purgatives besides diminish secretion by sweeping out of the intestine bile which might otherwise be

reabsorbed, and partially digested food which might furnish fresh bile. In this way cholagogues are also hepatic depressants.

(3.) CHOLAGOGUES **remove bile** from the body mainly **by increasing intestinal action.** Superfluous bile cannot be got rid of by a hepatic stimulant alone, which indeed increases the secretion, nor even by a hepatic depressant, which diminishes secretion, for, as already indicated, excess of bile is apt to lodge in the small intestine, and become reabsorbed. Effectually to get rid of it, the bowels must be freely moved, preferably by a purge which will produce sufficient mucous secretion to wash out the small intestines. The drugs which effect this are calomel and other purgative mercurial salts, aloes, jalap, podophyllin, and sulphates of potassium and sodium. Their effects are increased by active exertion. In dogs and other animals that vomit, emetics effectually remove bile by compressing the liver between the diaphragm and the abdominal muscles, diluting the bile with abundant mucous secretion, and promptly discharging it by the mouth as well as by the usual downward channel.

Owing to the low blood-pressure in the portal vein, and also the low pressure at which bile is secreted, there is little *vis a tergo* to overcome obstruction in the gall ducts, and hence the bile flow is rather liable to stagnation with consequent increased reabsorption. This is apt to occur in human patients living largely on albuminoid food, and not taking sufficient brisk exercise. It also occurs in cattle forced for exhibition, and in all animals as a concomitant of intestinal catarrh. It is frequent amongst horses suffering from influenza, and the circulation of bile accounts not only for the yellow membranes, but also, in great part, for the dulness and languor characterising such complaints. The removal of this superfluous bile, with the waste products it has helped to neutralise, in these cases is suitably affected by half a dose of physic, or by some calomel or grey powder, followed by salines. The nitro-muriatic acid and iron salts, which experience shows to be subsequently serviceable, owe their good effects, in part at least, to their action on the liver. In jaundice, the late Professor Robertson was wont to prescribe a purgative, followed by salines, and

subsequently administer twice daily a bolus of inspissated ox bile, alternating this with aromatic spirits of ammonia.

The pancreas has been termed an abdominal salivary gland, but its secretion not only converts starch into sugar, but also digests proteids, and breaks up and emulsifies fat. Not much is accurately known regarding the action of drugs upon it. Its secretion is increased when ether is introduced into the stomach, and diminished by atropine. Calomel and salicylic acid check decomposition of pancreatic juice.

Few investigations have yet been made regarding the action of drugs on the **spleen.**

ANTHELMINTICS are agents which **kill or expel intestinal worms.** They include **vermicides,** which kill the parasites, and **vermifuges,** such as purgatives, which, without necessarily killing, detach them from the walls of the canal, and wash them away with the mucus in which they are usually imbedded.

The parasites infesting the alimentary canal are—bots the larvæ of the œstrus bovis, found in the stomach of the horse; tape, round, and thread worms found in most veterinary patients; and fluke worms which invade the liver, gall-ducts, and intestines of sheep, and occasionally of other animals.

The appropriate vermicides are—

1. For **bots,** green food, a combination of aloes, asafœtida, turpentine and ether.

2. For **tape-worms,** areca nut, filixmas, kamala, kousso, pomegranate, turpentine, and chloroform.

3. For **round worms,** santonin, santonica.

4. For **thread worms,** turpentine and essential oils, tannin, and tannin-containing substances, with enemeta of common salt, iron chloride, or lime water.

5. For **fluke worms**—*Fasciola hepatica*—infesting the liver and gall-ducts of sheep, and occasionally of cattle and other animals, the treatment is confined to maintaining the patient's strength by good feeding; furnishing common salt and soluble iron salts, which exert general tonic effects and some limited vermicide action, and giving a dose of physic which hastens the removal of flukes which have migrated into the intestines. Prevention is insured by keeping the flock on sound pastures, free from the developmental forms of the parasite.

Bots in horses complete their larval stage in spring, and their discharge is then readily promoted by the laxative fresh green grass. During autumn or winter they are dislodged with difficulty, and unless numerous, and causing much irritation, their removal is seldom attempted; but animals seriously infested with them require liberal feeding. A considerable number of the larvæ may be dislodged by giving, after twelve hours' fast, two drachms each of aloes and asafœtida, dissolved in hot water, to which is added, when cold, half-an-ounce each of oil of turpentine and ether. The mixture is administered in gruel or linseed tea, and repeated on several consecutive days.

The two forms of **tape-worms,** and their varieties in horses, are usually destroyed by the above prescription. Whatever remedies are used, it is essential that the bowels be emptied as thoroughly as possible by fasting, or by a gentle aperient, in order that the vermicide shall be brought into contact with the head or scolex. Professor John Gamgee (*Veterinarian's Vade Mecum*) recommends two drachms of asafœtida, a drachm each of powdered savin and calomel, with thirty drops of the oil of the male shield fern, made up with treacle and linseed-meal, given at night, and followed by a purge next morning. Mr Robert Littler, of Long Clawson, both for tape and round worms, gives for three or four consecutive mornings a ball containing two drachms of copper sulphate, and follows this with a purgative dose of aloes.

The common **lumbricoid worm** (*Ascaris megalocephala*), usually occurring in the small intestines of horses, and the *Oxyuris curvula*, familiar as **ascarides,** and met with in the colon and rectum, are more easily got rid of than tape-worms, and are treated by any of the above prescriptions. When lodged in the rectum the oxyuris is readily removed by enemas of diluted turpentine or carbolic acid, decoction of quassia, or other bitters, as well as by lime water, or common salt.

The thread worms (*Strongylus filaria*), sometimes infesting the bowels, and still more common in the air passages of young cattle and lambs, when infesting the intestines, are destroyed by a few doses of turpentine and oil, when infesting the air passages, by inhalations of chlorine or sulphurous acid; while weakly

patients, which are always the greatest sufferers, are benefited by daily doses of iron chloride solution and liberal dietary.

Some of the most serious and fatal cases of parasitism, unfortunately, are beyond the reach of anthelmintics. **Trichinæ** get immured, in the muscles, the palisade worms develop aneurisms, the *Strongulus tetracanthus*, which causes the death of many Welsh ponies, becomes incisted in the mucous coat of the colon and rectum, and is thus protected from the action of medicinal agents. The treatment of such cases is limited to a dose of aloes, with mashes, nutritive food, and tonics, to sustain failing strength; Professor Cobbold discountenanced turpentine.

Dogs in some localities, in the proportion of fifty to every hundred, are infested with **tape worms**. The most effectual remedy is areca nut; about half a nut, or 15 to 20 grains, is the dose for an animal 25 to 40 lbs. weight. Amongst other remedies are a drachm of turpentine and two ounces of castor or linseed oil; the root-stalks, scales, and rootlets of the male shield fern, now reputed the most certain remedy for tape-worm in man; the pomegranate root bark; the flowers of the Abyssinian kousso, followed by a purge; the American remedy, emulsion of the pumpkin seed; and kamala, a Euphorbiaceous plant effectually used in India. Whichever tape-worm remedies are used, as in other patients, fasting is enjoined for twelve to twenty hours, or only a little milk or gruel is allowed; at intervals of fifteen minutes a couple of doses of the vermicide are administered; the patient, if in vigorous health, is still restricted to a moderate amount of milk or gruel, and next day receives another dose of the vermicide; an hour later has a dose of ether, shortly followed by a draught of oil, by which the head of the parasite should be discharged.

The most common **lumbricoid** of dogs, the *Ascaris marginata*, is attacked by three to five grains of santonin, the active crystalline principle of artemesia or worm-wood. Turpentine and oil, gentian, and other bitters, aconite and various other medicines also remove these round worms. The effect of vermicides, as already indicated, is greatly increased by first emptying the intestines by fasting or by a purgative, in order that the drug may act more directly on the parasite. Occasional doses of

salines and mineral tonics remove superfluous mucus which shelters the worms. The spread of parasitism is prevented by isolating infested animals, and keeping sound animals in uncontaminated clean quarters, and supplied with pure water and sound proper food.

REMEDIES ACTING ON TISSUE CHANGE.

RESTORATIVES—TONICS—HÆMATINICS—ALTERATIVES—ANTIPYRETICS—BLOOD-LETTING.

The various structures of healthy animal bodies are continually undergoing reconstruction, change, and devolution. Fresh materials or **restoratives,** in sufficient abundance, and containing in suitable proportion the constituents of the several tissues, are required. By digestion and assimilation, the food materials are prepared for their special uses. But these complex nutritive processes sometimes become deranged. Some fault occurs in the digestive enzymes; some want of activity or co-relation overtakes the presiding nervous centres; some delay takes place in the prompt and effectual removal of waste products by the bowels, kidneys, or skin. Hence arise muscular and nervous depression, expressed in dulness, debility, and diminished capacity for exertion. For such weakened, relaxed, unfit conditions, the appropriate remedies are **tonics.** Within the living organs and tissues themselves, further subtle reparative processes continuously occur, and certain drugs, termed **alteratives,** in an imperceptible way modify these remoter tissue-changes. The maintenance of a tolerably uniform temperature is essential to the performance of normal tissue-changes in warm-blooded animals. In fever, however, the temperature is increased, and the remedies employed for its reduction are **antipyretics,** or febrifuges.

Restoratives.—The bodies of all animals, especially when in a state of activity, are undergoing disintegration and waste, and their growth and repair hence require continual recuperation. **Food** must be provided in sufficient amount, of suitable quality, and with its several constituents in fitting proportion, to furnish appropriate nutriment for every tissue.

Water constitutes four-fifths of the total weight of most animals, is being constantly removed by the lungs, skin, kidneys, and intestines, and, unless restored at short intervals by suitable simple drinks, thirst and impaired health ensue. Even more continually imperative is the need of **pure air** to oxygenate the blood, maintain internal respiration and normal tissue-change, and remove waste products. The bodies of all the higher animals require, either in the form of food or as restorative medicines, varying supplies of their many constituents—phosphorus, specially for blood, bone, brain, and nerves; sulphur, for the skin and bile acids; fats, for cell-growth generally; iron, for the blood globules; salines, for the healthy restoration of the blood and most other parts.

Essential as are these requirements in health, they are even more so for **animals affected by disease**. Food then requires to be given with especial care, and in an easily digested form, for in all serious diseases the digestive functions are impaired, and require **physiological rest.** In many febrile complaints, alike of horses and cattle, the ordinary grains and dry fodders, being imperfectly digested or assimilated, are apt to produce or aggravate gastric derangement. Animals affected by febrile and inflammatory disorders should therefore be restricted to mashes, gruels, and such soft food, to which extra nutritive value can be given as required, by addition of milk, eggs, or beef-tea. Food should never be allowed to lie long before a sick animal. If not promptly cleared up, it should be removed, and in a couple of hours, or less time, a fresh supply offered. During and after debilitating diseases, patients fed, as they should be, on small amounts of rapidly-digested fare, obviously require such food more frequently than in health. With returning appetite a convalescent occasionally greedily eats more than is good for him, and against this contingency well-intentioned attendants require to be warned. Many relapses of colic and lymphangitis occur by allowing horses, so soon as they will eat, to return at once to their full allowance of dry corn and hay.

Unless when affected with diarrhœa, dysentery, or diabetes, animals do not injure themselves by taking too much **water** or **watery fluids,** but are often rendered uncomfortable, while

recovery is retarded, by undue restriction. A supply of water should always be within the patient's reach. Cold water never does harm, and is more palatable and refreshing than when given tepid. Salines, chalk, and such simple medicines, sometimes supplied in the drink offered to sick horses, require to be sparingly added, and, if they render the water at all distasteful, must be administered in some other way.

Much mismanagement occurs with regard to the **ventilation** and **temperature** of the habitations of sick animals. Even for horses or cattle accustomed to comfortable boxes, a temperature of 60° to 65° F. is sufficiently warm. Avoiding draughts, cool air should be freely admitted. No restorative or tonic is so effectual as cool pure air, and it is especially needful in diseases of the respiratory organs and in zymotic cases. **Sunlight** is also an essential factor of health, especially in young animals. It increases the capacity of the blood and tissues for oxygen, and favours healthy excretion.

A comfortable bed greatly conduces to the restoration of most sick animals. A sick, exhausted horse, who to his disadvantage would continue to stand if kept tied in a stall, will often at once lie down and rest if placed in a comfortable box. In febrile and inflammatory attacks, and during recovery from exhausting disease, alike in horses and cattle, a **warm rug** or two, and **bandages** to the legs, help to maintain equable temperature and combat congestion of internal organs; but at least twice daily these rugs and bandages should be stripped off, the skin wisped over, and the clothing at once re-applied. In fever, when the skin is hot and dry, great comfort results, a more natural moist state of skin is secured, and more active blood purification and restoration ensue, from carefully sponging the body several times a day with tepid water acidulated with vinegar, quickly drying, and at once putting on the clothing.

Physiological rest is a great restorative. The pain accompanying most injuries and diseases, and greatly aggravated by performance of the natural functions of the part, instinctively enjoins as much rest as possible. An inflamed part, when practicable, should be raised above the level of surrounding parts. Any pressure likely to interfere with circulation should

be removed. To obviate irritation, pressure and tension, the inflamed udder of the cow should be suspended; the horse with laminitis coaxed to lie or placed in slings. In irritable and inflammatory states of the digestive organs, the simplest and most digestible food is given, and as little duty as possible exacted from the stomach and bowels. Again when the kidneys are diseased, their work should be lightened, and the skin and bowels got vicariously to undertake the chief excretory services. But when acute disease has passed away, the gradual use of an affected part generally does good. **Exercise** in such circumstances proves a health-restorer, improving appetite, and promoting the several excretory functions.

Of **medicinal restoratives,** those in most common use are linseed, which, in the form of gruel, tea, or cake, proves a soothing, palatable, digestible laxative combination of food and medicine. Cod-liver oil, especially in dogs and cats, conveniently supplies assimilable fatty matters. Iron salts, possessing tonic and hæmatinic, as well as restorative properties, are specially serviceable in anæmia; phosphates are prescribed for ill-thriving, weakly young animals; salines are indicated in skin eruptions and itching, often met with amongst hard-worked, liberally-fed horses; artificial pepsin and pancreatin are sometimes administered to dogs and calves when the natural digestive ferments are deficient or faulty.

TONICS.—When digestion is enfeebled, nutrition impaired circulation languid, or waste products not promptly removed there is apt to ensue weakness, want of energy, and unfitness for work—conditions treated for the most part by tonics. They are defined as remedies which **impart strength** to the parts on which they specially act. They are allied to nutrients and restoratives. They resemble stimulants; but their effects are more slowly and gradually produced, are more permanent, and not succeeded by subsequent depression. While stimulants usually call forth strength previously latent, tonics frequently give strength. They are also allied to astringents, but do not exhibit the same chemical power of coagulating albumin and condensing tissues. The same drugs, in different doses, often appear, however, in two or more of these classes. Alcohol, for example, is nutrient, tonic, and

stimulant. Iron salts, according to their dose and the state of the patient, are nutrient, tonic, and astringent, and, used improperly, are sometimes irritant.

In the **use of tonics,** it is essential to discover what part or organ is primarily and chiefly at fault. When digestion is enfeebled, gastric or intestinal tonics are prescribed (p. 75). When the pulse is soft and weak, with a tendency to local congestion and œdema, cardiac and vascular tonics are used (pp. 61 and 62). When nervous functions are imperfectly performed, nervine tonics are appropriate (pp. 42 and 52). In the early stages of tuberculous disease of the mesenteric glands, in cattle and sheep, and also in farcy in horses, copper sulphate is often useful, probably on account alike of its tonic and antiseptic properties. Cold, in the form of baths, douches, and sponging, proves a valuable tonic, applicable for general as well as local purposes, relieving irritability, bracing up soft flabby textures, and equalising circulation.

HÆMATINICS, or blood tonics, constitute an important group of tonics, which increase the quantity of red corpuscles and hæmoglobin in the blood. "The red blood corpuscles are probably formed in the spleen, the medulla of bones, the liver, and possibly other parts of the body, from leucocytes, which lose their nucleus, take up hæmoglobin, and alter their form to that of the red corpuscles" (*Brunton*). These red corpuscles are in great part destroyed in the liver and spleen, and it hence appears probable that disorder of these organs is an essential cause of anæmia, which is very common amongst all badly-reared young animals. In order to restore iron and fatty matters which are deficient in anæmic blood, daily doses of soluble iron salts are prescribed, while easily assimilated fatty matters, such as boiled linseed, or linseed cake, are given to horses and cattle, and cod-liver oil to dogs. An improvement of general health is further effected by judicious feeding and comfortable quarters. The anæmia resulting from debilitating disease requires similar treatment. To ensure their good effects, tonics are generally given in moderate doses, two or three times daily, for six or eight days, and throughout their administration the bowels should be kept in a regular normal state.

Alteratives are drugs which **influence the amount and kind of tissue-change going on in different organs and cells.** "They produce," Dr. Lauder Brunton states, "no marked corresponding changes in assimilation, circulation, or excretion. It is uncertain how they act; it is possible that they may alter in some way the action of enzymes in the body, but it is also possible that they act by replacing the normal constituents of the tissues, and forming compounds which tend to break up in a different way from those which are ordinarily present. Thus chloride of sodium, and nitrogenous bodies such as albumin, are amongst the most important constituents of the body; and we find that among the chief alteratives are substances which will replace chlorine, sodium, or nitrogen in many compounds. Thus we have iodine and iodides, and nitric or nitro-hydrochloric acids, which will displace or replace chlorine. We have chlorine itself, and chlorides, which may alter the proportion of chlorides to other salts in the blood and tissues, and thus modify the solubility of various constituents of the tissues. We have salts of potassium and calcium, which may replace those of sodium; sulphur and sulphides, which may replace oxygen; phosphorus, hyposulphites, antimony, and arsenic, which may replace nitrogen; mercury and its salts, which may replace calcium. Besides these, we have organic alteratives, regarding the action of which we can at present form no hypothesis, unless they influence the processes of digestion. Nitro-hydrochloric acid, taraxacum, and small doses of mercurials probably act either by modifying the digestion of food in the duodenum and jejunum, or by modifying the changes which it undergoes in the liver after absorption" ("Pharmacology, Therapeutics, and Materia Medica").

Sodium chloride, sulphate, phosphate, acetate, and biborate, potassium nitrate, ammonium chloride and carbonate, and probably all salts excreted by the kidneys, increase tissue-change and the amount of urea excreted. Fats and fatty acids lessen decomposition of albuminoids and excretion of urea, but glycerin has no such action. Alcohol, in small or moderate doses, lessens—and in large doses increases—tissue-change. Benzoic and salicylic acids increase tissue-change

Quinine lessens, iron appears to increase it. Mercury also causes a slight increase, but has a peculiar power of breaking up new deposits of fibrin, and hence is used to remove lymph deposits and prevent adhesions. Iodine, iodides, and probably also chlorides, apparently act on the lymphatic system, promoting absorption. In general malnutrition, without definite symptoms, mercurials, nitro-hydrochloric acid, and taraxacum are indicated; and especially when the liver appears to be at fault. Antimony, arsenic, and phosphorus exert their actions notably on the glandular, nervous, respiratory, and cutaneous systems, and in large quantities, affect the liver in a marked manner, producing fatty degeneration; and this also results in other tissues. Antimony is prescribed in acute disorders of the respiratory organs; arsenic, in chronic consolidations, which it probably softens by fatty degeneration. Arsenic is also employed in chronic skin diseases, such as psoriasas, lichen and eczema. Phosphorus and arsenic are prescribed in nervous debility.

ANTIPYRETICS **lower the temperature of the body in fever.** Their effects are more notable when the temperature is abnormal. **Animal heat** is chiefly **produced by oxidation,** in the muscles both voluntary and involuntary, and in glands, especially when they are in a state of activity. It is **given off** by the skin and lungs, in small amount, by radiation; in still larger amount by contact with cold water or cold air, the latter abstracting heat with especial rapidity when it is damp or in motion. Owing to diminished activity of the cerebro-vaso-motor centre, and consequent dilatation of the surface-vessels, loss of heat is greater when animals are asleep than when awake. Conversely, more heat is produced when the animal is in active motion, and blood circulates freely through the heat-producing apparatus of the muscles and glands. Small animals, having a cooling surface relatively larger than their interior heating appliances, are more rapidly cooled than large animals. A centre has been found in the corpus striatum, which appears to regulate the production of heat, and certain antipyretics appear to develop their effects by stimulating this centre.

Antipyretics are divided by Dr. Lauder Brunton into two classes—those which **lessen production of heat,** and those

which **increase loss of heat**; and these again he sub-divides as shown in the subjoined table:—

Antipyretics.	Lessen production of heat.	Acting on Tissue-Change:		Cinchona Alkaloids. Benzoic and Carbolic Acids. Salicylic Acid. Salicylicates. Salicin. Camphor. Eucalyptol. Thymol and other essential Oils. Alcohol. Perfect Rest.
		Acting on the Circulation:	Generally	Antimony Salts. Aconite. Digitalis. Veratrine.
			Locally	Local Blood-letting. Poultices. Blisters.
	Increase loss of heat.	By dilating cutaneous vessels and increasing radiation:		Alcohol Nitrous Ether. Antipyrin.
		By increasing the loss of heat due to evaporation of perspiration: Sudorifics:		Antimonial Preparations. Opium and Ipecacuanha. Nitrous Ether.
		By abstracting heat from the body: . . .		Cold Baths. Cold Sponging. Wet Pack. Ice to the Surface. Cold Drinks. Cold Enemata.
	Mode of action uncertain.	Purgatives. Venesection.		

Anitpyretics affect the blood and tissues chiefly by retarding oxidation of protoplasm, and white and red blood globules in the manner already referred to (p. 22). On the circulation,

their action probably depends on their diminishing the volume and rapidity of the blood stream, as is done **generally** by aconite and digitalis, and **locally** by blisters and poultices. Antipyretics increase in several ways the loss of heat.

(1.) They dilate the cutaneous vessels, augmenting radiation of heat from the body, as is effected by alcohol and antipyrin.

(2.) They promote secretion of sweat, and thus increase cooling evaporation, as is effected by diaphoretics.

(3.) They directly remove heat, as is effected by cold baths, cold affusion, etc.

Antipyretics are **used to lower abnormal temperature,** whether caused by prolonged exposure to heat or by febrile disease. In horses and cattle, a safe and effectual method consists in quickly sponging the patient with cold water, rapidly drying, and comfortably clothing him. Heat is thus directly removed. The cooling functions of the skin, which are impaired in most febrile attacks, are re-established, and their action may be further stimulated by the administration of ammonia salts, ethers, and alcohol. In its several forms, alcohol exerts a two-fold effect, diminishing oxidation, and also dilating cutaneous vessels, and thus accelerating cooling. Bleeding, both general and local, judiciously and cautiously used, lowers abnormal temperature by relieving alike symptomatic fever and local inflammation. Purgatives have somewhat similar adjuvant effects, and doubtless are further serviceable in hastening the removal from the body of those waste products, which are notable causes of increased temperature.

Blood-letting promptly and directly affects tissue-changes. It rapidly removes from the body nutrient materials, and especially blood globules. A full bleeding **diminishes the activity of all vital functions,** excepting the production of blood globules. The heart-beat is quickened, but its force is lessened; arterial tension is lowered; absorption is increased; sensibility to pain is diminished, owing to reduced activity of the peripheral centres. When blood is lost rapidly or freely, nausea, fainting, and epilepti-form convulsions ensue, and artificial anæmia is produced. In healthy subjects, however, these effects quickly disappear, and the blood is rapidly restored to its normal state.

Until within the last thirty years, blood-letting was freely used in veterinary practice, and very generally abused. It has hence fallen into disrepute, and is not now employed even in cases of **acute congestion** and **inflammation,** which it is especially fitted to control. It may be used either **generally** or **locally.** In robust subjects, in acute congestion or hæmorrhage from the lungs, especially when accompanied by venous stasis, blood-letting affords prompt, and frequently permanent, relief. In the first onset of puerperal apoplexy in cattle, it checks the restlessness, delirium, or stupor, and affords time for the operation of purgatives and other drugs. Alike in horses and cattle, it is serviceable where fever is acute, with a firm, incompressible, or full, slow, indistinct pulse, as in inflammation of the pleura, peritoneum, or brain, as well as in acute rheumatism. In lymphangitis, and in some cases of laminitis in horses, it is also useful. Dogs are so readily brought under the influence of emetics and nauseants that bleeding is less needed in them than in horses and ruminants.

In adult horses or cattle, blood may generally be taken to the extent of three or four quarts. The amount drawn must be accurately measured by being received into a graduated vessel. The circumstances of the case materially affect the amount of blood to be drawn. It should flow freely until its abstraction has made a decided impression on the volume and strength of the pulse, or until the earliest symptoms of nausea are apparent. Blood should be drawn rapidly from a tolerably large opening, as its important influence in relieving arterial tension is thus produced more rapidly and decidedly, and with less expenditure of the vital fluids. The jugular vein on either side is generally selected as the vessel on which it is most convenient and safe to operate. Bleeding from considerable arteries is not more effectual than from veins, and the flow is more troublesome to arrest. Excepting in expert professional hands, fleams are safer than the lancet, which occasionally in restive horses makes an ugly gash. When practicable, the horse should be bled with his head erect, for in this position the nauseating effects, which testify that no more blood can be spared, are most noticeable. When blood sufficient has been taken, the edges of the wound are brought

accurately together, and secured by a pin, round which is wound some thread, tow, or hair.

Blood-letting, although valuable in the earlier stages of acute inflammation in vigorous animals, **is injurious** in young or weakly subjects, in the latter stages of disease, in epizootic and eruptive fevers, and indeed, wherever the pulse is small, quick, or weak. A pulse of this character indicates debility, and bleeding in such cases increases exudation and effusion instead of preventing them, while it unnecessarily weakens the patient and retards recovery. While blood is being drawn, the finger in all animals should be placed upon a prominent artery, and if the pulse is observed to become quicker or weaker, or begins to flutter, it is evident that the treatment is unsuitable. Such mischance should, however, never happen, for when there is any question as to the propriety of blood-letting, the animal should have the benefit of the doubt, and such a reducing remedy should be avoided.

Local Blood-letting is not much practised among the lower animals. Lancing the tumid gums of teething horses is seldom necessary, especially if soft food is supplied, as it should be in such cases. In laminitis some practitioners pare down the horny sole, and open the vessels of the sensitive sole, encouraging the flow of blood by immersing the foot in hot water or in a warm poultice; but in such cases the heat and moisture are generally of more benefit than the bleeding. Cupping and leeches are not used in veterinary practice.

MEDICINES ACTING ON THE URINARY ORGANS.

ON THE KIDNEYS :—DIURETICS.

Diuretics are agents which **act on the kidneys** and **increase secretion** of **urine.**

The Kidneys have a threefold action :—

(1.) They remove from the body excess of water.
(2.) They excrete waste products.
(3.) They retain and re-absorb water.

These functions are mainly performed by three separate portions of the kidney :—

(1.) The Malpighian corpuscles or glomeruli, mainly by a process of mechanical transudation, eliminate water, containing some solid matters.

(2.) The uriniferous tubules of the cortical substance, and the epithelial cells lining them, mostly excrete unused or waste materials dissolved in a limited quantity of water. Urea and other such nitrogenous waste products in the blood are the natural stimulants of this secreting function.

(3.) The constrictions in the tubules retard rapid outflow of water, and favour its re-absorption after it has washed out the waste products, as notably occurs in birds and reptiles, and in many mammalia in hot weather.

The amount of urine is liable to considerable variation, depending mainly on the nature of the food, the quantity of water drunk, and the proportion of fluid removed by the bowels and skin. Horses during the twenty-four hours pass from two quarts to two gallons, or on an average about ten pints. Secretion is augmented during digestion and is largely increased by such food as heated oats or musty hay, and by vetches, especially when animals are unused to them. Mr Frederick Smith of the Veterinary School, Aldershot, has recently made a series of examinations of the urine of horses, and finds the specific gravity range from 1035 to 1040, and that every ounce contains about 12·39 grains of urea, or a total of upwards of five ounces in the twenty-four hours (*Veterinary Journal*, September 1887). Cattle pass in the twenty-four hours from two to three gallons of urine, which contains more potassium hippurate and sulphate and common salt, but less urea and less calcium carbonate than that of the horse. Of the fluid ingesta the kidneys of the horse remove about 14 per cent, of dogs nearly 50 per cent, of man about 54 per cent. The two kidneys do not act in perfect unison; while one is mostly removing concentrated excrementitious matters, the other gets rid of greatly more diluted urine, and this service is alternated.

The urinary **secretion** is **increased** by a variety of conditions: notably by raising the pressure of blood in the

Malpighian corpuscles, by cardiac stimulation, as also by contraction of the blood-vessels of other vascular areas, as when cold diminishes cutaneous activity. Irritation of the medulla in the floor of the fourth ventricle experimentally produced by mechanical injury, or naturally produced by circulation of venous blood, greatly increases secretion, owing, it is believed, to stimulation of the special vaso-motor centre which regulates the renal arteries. Subsidiary centres are also found in the spinal cord, and in the solar and mesenteric plexuses, all of them contributing in the regulation of the secretion of the kidneys.

The proportion of the several urinary constitutents is altered by different conditions. Urea, uric acid, and hippuric acid are increased by nitrogenous food, by common salt, phosphoric acid, leucin, and glycocol, and are also augmented during the early stages of most acute diseases. They are diminished by alcohol, turpentine, arsenic, and large draughts of water. Horses at rest pass a maximum of uric acid and a minimum of the less perfectly oxidised hippuric acid, but these proportions are reversed during and immediately after exertion, when disintegration of albuminoid tissues freely uses up oxygen and increases production of carbonic acid.

Albumin is not a normal constituent of urine, but occurs in convalescence from most febrile disorders, temporarily in horses receiving excess of albuminous food, and also in hæmoglobinuria (azoturia) in horses, and red water in cattle. It appears where contraction of the renal arteries has been induced by digitalis or strychnine; and is likewise produced by full doses of cantharides, which also causes hæmaturia. Such exudation of albumin, which is more apt to appear suddenly and temporarily in horses than in man, is lessened by administration of tannin, and by arbutin, the active principle of uva ursi, and also by keeping the bowels and skin in proper action, clothing the patient comfortably, but avoiding active diuretics. Bile constituents are occasionally found in the urine of the lower animals, but sugar is rarely present.

Classifying diuretics as refrigerant, hydragogue and stimulant, Dr Lauder Brunton presents the subjoined tabular view of their probable modes of action :—

- Raise arterial pressure.
  - Generally
    - Increased action of the heart: Digitalis; Alcohol
    - Contraction of vessels in intestines and throughout the body:
    - Digitalis. Erythrophlœum Strophanthus. Squill. Convallaria. Strychnine. Caffeine. Cold to surface.
  - Locally in kidney.
    - Contract efferent arterioles of glomeruli, so as to raise pressure in glomerulus, or lessen absorption in tubules or both:
      - By action on vaso-motor centres: The same as in preceding list.
      - By local action on vessels or nervous structures in the kidney itself: Broom. Turpentine. Juniper. Copaiba. Cantharides.
    - Dilate efferent vessels:
      - Paralyse vaso-motor nerves, or involuntary muscular fibre, or stimulate vaso-dilating nerves: Nitrites. Alcohol. Urea.
- Act on the secretory nerves or secretory cells of the kidney itself.
  - Increase water excreted: Urea. Caffeine. Calomel.
  - Increase salts excreted: Liquor Potassæ. Potassium Acetate, &c. Other Saline Diuretics.

A suitable diuretic ball for the horse is made with half an ounce each of nitre, resin, and soft soap, and may be repeated daily for four or five days. When it is sought to increase the solid as well as the watery parts of the urine, ten or fifteen grains of powdered digitalis are added. The same ingredients dissolved in a pint of water make a diuretic drink for the cow. For a medium-sized dog, Stonehenge advises six grains of nitre, a grain of digitalis, and three grains of ginger, made into a pill with linseed meal and water. Another useful combination consists of thirty drops of sweet spirit of nitre and five grains saltpetre in a little water. Diuretic effects are best insured by conjoining several drugs, by giving small and repeated doses, and by encouraging the animal to drink tolerably freely of water, thin gruel, or other bland fluids, and otherwise promoting excretion of the medicine by the kidneys rather than by the skin or bowels.

Diuretics **are used**:

(1.) **To remove excess of fluid** from the tissues or serous cavities. For such purposes digitalis, strophanthus, and other drugs which act on the vascular system generally, are indicated; while their efficacy is rendered more certain when they are conjoined with some saline diuretic such as nitre. In dropsy connected with chronic kidney disease, nitrous ether and oil of juniper are preferred; but must be used with extreme caution.

(2.) **To hasten expulsion of waste products** and poisonous matters from the body, as in febrile disorders or where the kidneys are acting tardily. In these as in other cases, a combination of diuretics is desirable, and turpentine or oil of juniper is often usefully conjoined with nitre. In human practice caffeine is prescribed.

(3.) **To increase the proportion of water** in the urine, thus preventing deposition of its solids in the kidneys or bladder, and mechanically washing out such solids when they have been formed. Along with medicinal diuretics, diluents in such cases are freely supplied.

As adjuvants, where venous congestion occurs, a purgative is often useful. Calomel augments secretion of urea, and hence promotes secretion of urine. In excessive or too frequently repeated doses diuretics are apt unduly to stimulate the kidneys and urinary organs, and provoke strangury inflammation and hæmaturia.

MEDICINES ACTING ON THE BLADDER.

LITHONTRIPTICS—URINARY SEDATIVES, TONICS, AND ASTRINGENTS.

The movements of the urinary bladder are mainly regulated by a centre in the lumbar portion of the spinal cord, but in all the higher animals there is also a presiding centre in the brain, which may be set in action either voluntarily or reflexly. Most drugs influencing the bladder appear, however, to come into actual contact with it, and produce their effects reflexly. Some horses have great objections to urinate while in harness; others will not while the rider is in the saddle. As with other animals, the desire to urinate is suggested, and the act facilitated, by seeing or hearing other animals staling, or even

by the sound of flowing water. If, as is often the case, the horse is in the habit of being whistled to when urinating, the act will be encouraged by whistling to him.

Hard-fed and hard-worked horses are liable to suffer from urinary deposits, which are sometimes found in the kidney, but more commonly in the bladder, and in male animals in the track of the long curved urethra. **In horses,** as in other herbivora, **urinary deposits** consist mainly of calcium and magnesium salts, sometimes derived directly from hard drinking waters, from earthy matters mixed with fodder or grain, or from lime salts abundant in clovers and other fodder, and which unite with the carbonates produced by oxidation of the vegetable acids also present in the food. These calcareous deposits are sometimes in a finely-divided pulverulent state, sometimes they are aggregated into one or more masses or stones. Whether occurring as sediment, gravel, or stone, they cause more or less difficulty, straining, and pain in urination; the stream is interrupted, and from irritation of the lining membrane of the urinary passages it usually contains excess of mucus; while the portions last discharged are often turbid. When such symptoms depend upon the presence of a stone in the bladder, medical treatment is unavailing. No medicine can be given in sufficient amount or sufficiently concentrated to dissolve calcareous urinary deposits within the body. Hence a stone which cannot be naturally discharged can only be removed by a surgical operation. When not too large it may be extracted by lithotomy; or, when large or of awkward shape, it may first be reduced. Calcareous sediment can usually be got rid of in great part, or entirely, by giving liberal supplies of barley water, linseed tea, or other diluents, which mechanically wash out the urinary organs. Very readily in the mare, and with a syringe and flexible catheter in the horse, the bladder may be filled with tepid water, and deposits thus washed out. Successive quantities of water may be introduced until they come away tolerably clear.

LITHONTRIPTICS are defined as remedies which prevent deposit of solids from the urine, or cause their resolution. In veterinary patients, as already indicated, they cannot resolve solid deposits, although they may mechanically remove them,

and may check their formation. Such preventive treatment in the case of horses mainly consists in furnishing abundant, regular, and pure supplies of drinking water. Waters rich in calcareous matters are theoretically more liable to deposit such earthy constituents, especially under conditions where their carbonic anhydride is diminished. A weekly mash, containing any simple saline, somewhat lessens the tendency to these urinary deposits; and it is further important to remove any conditions which interfere with regular urination or any obstructions to the outflow. It is accordingly desirable, several times a week, thoroughly to wash out the horse's sheath and prepuce with soap and tepid water, and thus get rid of accumulating sabulous matter.

Bulls and oxen, and still more frequently **rams and wethers,** when liberally supplied with albuminoid food, and having little or no exercise, are liable to deposits chiefly of **ammonio-magnesian phosphates** in the bladder and tortuous constrictions of the urethra. Amongst feeding sheep, fatal uræmic poisoning is thus produced. The patients must be turned up, and endeavour made by manipulation to displace the deposits which block the course of the urethra. Where these means fail to effect a passage, the vermiform appendage may be cut off, when a full stream of urine will be discharged, and with it a considerable amount of deposit. Prevention is effected by withholding or reducing the allowance of cake and corn, supplying soft laxative food, raising the sheep and moving them about at least thrice daily, so as to encourage urination, and prescribing potassium carbonate.

Dogs, when freely eating animal food,. suffer occasionally from deposits of **uric acid** and **acid urates,** the tendency to which is combated by suitable diet, diluents, and salts of potassium and lithium, both of which form soluble salts with uric acid, but the lithium having a lower atomic weight, unites with a larger proportion of uric acid.

VESICAL AND URINARY SEDATIVES are agents which **lessen irritability** of the bladder and urinary passages, and thus remove straining and pain. Diluents, such as linseed tea or other mucilaginous drinks, are often serviceable. Irritability caused by the presence of calculi is diminished by administering

calcium carbonate. In cystitis, rugs wrung out of hot water and laid over the loins, and hot fomentations to the perineum, afford much relief. Irritability of the nerve-centres is soothed by opium, belladonna, and hyoscyamus Chronic inflammatory conditions are relieved by such astringents as uva ursi and buchu. Copiaba, sandal-wood oil, and terpenes are excreted in considerable amount by the kidneys, and exert their antiseptic and astringent effects throughout the urino-genital mucous surfaces. Relaxed and hæmorrhagic conditions of the tract were treated by the late Professor Robertson by sulphuric acid and iron sulphate, alternated by salicylic acid.

Vesical and Urinary Tonics are agents which increase the contractility of the involuntary muscular walls of the bladder. Some, like potassium bromide, strengthen the detrusor urinæ muscles, and thus prevent retention; others, like strychnine and cantharides, strengthen the sphincter vesicæ, and thus prevent involuntary escape of urine. Belladonna acts upon the regulating nerve-centres, and is believed to lessen their sensibility.

MEDICINES ACTING ON THE ORGANS OF GENERATION.

APHRODISIACS—ANAPHRODISIACS—ECBOLICS.

The **sexual function** is regulated by two nerve centres, which influence and re-act on each other.

(1.) The cerebral is believed to lie in the crus cerebri, is stimulated reflexly by the special nerves of smell, sight, or hearing. (2.) The spinal centre situated in the lumbar region regulates the dilatation of the arterials and the compression of the efferent veins in the erectile genital tissues, thus producing turgid rigidity. Erection is also produced reflexly by local irritation of the genital organs, as well as by irritation of the bladder, prostate and lower intestines.

Aphrodisiacs are agents which **increase sexual appetite.** Deficient sexual activity usually depends upon want of general vigour, and hence cannot be amended by the old popular remedy of switching the animal's hind parts with nettles. The more rational and effectual treatment consists in the adminis-

tration of tonics—notably of iron and of strychnine, which, in addition to its general action as a nervine tonic, has also a special effect in stimulating the sexual centres. Cantharides produces aphrodisiac influences mainly by irritating the urinary mucous membrane, and hence is an unsafe remedy. Alcohol, although stimulating the cerebral sexual centre, appears to paralyse the lumbar vaso-motor centres, and hence interferes with the proper performance of the generative act.

Anaphrodisiacs are agents which **diminish the sexual passion.** They may act locally on the organs themselves, as is the effect of applications of ice or cold water; or generally on the genital nerve-centres, as do potassium iodide and bromide, purgatives, digitalis, and camphor. A spare diet and steady work exert anaphrodisiac effects. Irritation of the genital lumbar plexus is produced reflexly by distension of the bladder with acrid urine, by accumulation of filth around the prepuce, by ascarides, and even by fæces in the rectum. Removal of such causes of irritation accordingly diminish undue sexual excitement.

Ecbolics.—The involuntary muscular fibres of the uterus have the power of rythmical contraction, but are besides controlled by higher nerve-centres, one set of which are in the lumbar portion of the cord, and the other in the brain. Experiments have demonstrated that stimulation of the cerebellum, crura cerebri, corpora striata, and optic thalami, produce uterine contractions. One set of nerves going to the uterus induce circular contractions with protrusion of the cervix and dilatation of the os; while another contract longitudinally, causing retraction of the cervix and closure of the os.

Ecbolics cause expulsion of the contents of the uterus. They include ergot, hydrastis, savin, and thuja; but ergot is the only one in general use. It induces uterine contractions even when all nervous connections have been divided, but it also acts on the special centre. It is occasionally **used** in veterinary patients—particularly in the bitch—to hasten parturition when no obstruction is present, but when expulsive power is deficient. As it induces persistent contraction of the uterus, with consequent arrest of placental circulation, it must be used only sparingly and cautiously during parturition. It

is serviceable, however, subsequently in promoting contraction and checking hæmorrhage. Prompt contraction of the flaccid uterus, with arrest of dangerous bleeding, is best secured by subcutaneous injection of ergotin, and also by injection of warm water.

The local irritation of metritis and leucorrhæa is also relieved by injection of water, used as warm as the animal can bear it, and rendered still more effectual by addition of Condy's fluid, chlorine solution or carbolic acid. Suppositories of opium and belladonna may be subsequently introduced.

Agents Acting on the Mammary Glands.—An ample stream of well nourished blood passing through the mammary glands is essential for the abundant secretion of good milk. Animals which are to milk well must accordingly be fed well. Their diet must contain a sufficient proportion especially of albuminoids and fatty matters, which furnish the casein and cream of the milk. There are no drugs of much practical value as **galactagogues,** or **increasers of the milk.** Jaborandi exerts only a temporary effect. Many drugs, however, pass into the milk, communicating to it their flavour and medicinal properties. Ethereal oils promptly taste the milk of any animal to which they are given. Fixed oils and salines administered to milking mothers, purge the sucking offspring. Acids, diuretics, opiates, and many other drugs given to suckling mothers, exhibit less notable effects on them, than on their more susceptible progeny.

By careful selection of good milking bovine tribes, and by suitable feeding and milking three times daily, the milk yielded by first-class dairy cows is many times that obtained from cattle in their normal or semi-feral state, which furnish only sufficient for the rearing of one calf. But the highly developed mammary organs of these improved dairy animals become increasingly liable to disease, and less amenable to treatment. Acute inflammation frequently attacks one or more quarters of the udder, causing much constitutional disturbance, and necessitating the administration of a smart purgative, and of febrifuges. A large udder when it becomes inflamed, in order to relieve its dependent position and weight, must be suspended by a broad web passed over the back and loins.

The web will conveniently support the light poultice of spent hops, which is often advantageously applied. In the web, holes are cut for the teats, so that milk, which, if allowed to remain, increases irritation, may be removed four or five times a day. A teat-syphon is generally useful to withdraw the milk with as little pressure in handling as possible. The inflamed parts are dressed with belladonna, which, as is its wont, paralyses the vaso-motor nerves, thus diminishing lacteal secretion; and also relaxes muscular fibres, thus relieving tension, loosening the sphincters of the teats, and hence facilitating removal of milk. These desirable results are sometimes obtained by the hypodermic injection of atropine.

With the view of hastening the drying of cows, belladonna is sometimes applied topically to the udder, and is also administered; but the desired object is more practically attained by restricting the cow to dry food, milking her at gradually lengthening intervals, and where the result has to be quickly secured, giving besides a dose of physic.

MEDICINES ACTING ON THE SKIN.

DIAPHORETICS—SUDORIFICS—ANHIDROTICS.

The skin of the domesticated animals performs several very important functions. Besides being a protecting envelope it **removes daily** about 1-67th of the weight of the body, about 1·30 per cent. being solids, of which one-fourth are **inorganic matters,** and three-fourths are **organic,** consisting chiefly of fats, fatty acids, and about one-tenth of urea. Sanctorius' experiments shew that of eight parts of food taken into the healthy body, about three parts leave it in the fæces and urine, three by the lungs, and two by the skin. On account of its constant and large secretion of fluid, the skin is an important factor in regulating animal temperature. It is an important breathing apparatus, excreting carbonic acid and absorbing oxygen. The proportion of carbonic acid removed by the skin as compared with the pulmonary membrane is as 1 to 200; the amount of oxygen absorbed as 1 to 180. The azotised matters got rid of vary greatly with the food con-

sumed and with the activity of the kidneys, and range in man from 14·25 grains to 107 grains per hour.

So important are these **purifying functions,** that when they are arrested by coating considerable portions of the skin of small animals with a thin varnish, febrile symptoms and albuminuria are produced; while complete suppression of perspiration, effected by enveloping such an animal as a dog in a thin coat of varnish, determines imperfect arterialisation of the blood, lowering of temperature, and fatal asphyxia. Further illustration of the evils of arrested perspiration is afforded by Röhrig's experiment of the injection of $3\frac{1}{2}$ centimetres of freshly-filtered human sweat into the external jugular of a rabbit, which was nearly killed, the temperature promptly rising from 99·2 to 104·3, the pulse mounting from 192 to 315, the respirations from 85 to 105.

The sweat glands placed in the subcutaneous adipose tissue number 2000 to 3000 on every square inch of the surface of men and horses. They eliminate all the sensible and most of the insensible perspiration. Their activity is regulated by the special centres which are situated in the anterior horns of the grey matter of the spinal cord, and send nerve-fibres to the fore extremities, along with the anterior roots of the last cervical nerves, and to the posterior extremities with the dorsal and lumbar nerves. The amount of natural perspiration depends mainly upon the dryness and temperature of the air. Sweating in men and horses begins, even while they are at rest, a little over 80° Fahr. It is chiefly determined (1) by increased circulation of blood through the cutaneous vessels, and (2) by increased activity of the sweat glands. The taking of food, the drinking of warm water, or other bland fluids, the administration of strong tea and coffee, and active exercise, by raising arterial pressure, increase blood circulation through the cutaneous vessels, and promote perspiration. The sweat glands are stimulated by various aromatic and volatile substances which are excreted by them. The sweat centres are stimulated by ammonia salts, ipecacuanha, opium, camphor, nicotine, and antimony salts, by mental emotions and nausea, by a venous condition and high temperature of the blood, and reflexly by warmth to the surface, warm drinks, alcohol and pilocarpine.

Diaphoretics and **sudorifics** are agents which **increase** the **skin secretions.** Their actions differ only in degree, and are somewhat less prompt and certain in veterinary than in human patients. Horses are made to perspire more readily than cattle, while the skin of horses and cattle is more easily acted upon than that of dogs, pigs, or sheep. In all animals the readiest way of promoting full action of the skin is by heavy clothing, warm diluents, and keeping the animal in a dry atmosphere of about 70°. Small and repeated doses should also be given of some of the following medicines, which specially stimulate the sweat glands, namely, ammonia acetate solution, sweet spirit of nitre, sulphuric ether, diluted spirits, jaborandi, ipecacuanha, or Dover's powder. General stimulants in small doses raise arterial pressure, and hence usually increase skin secretion. When, however, blood-pressure is high, as in the early stages of acute inflammation, sedatives, such as aconite, or blood-letting, by reducing the action of the heart and blood-pressure, notably increase cutaneous secretion. Friction or grooming with suitable brushes beneficially excites the action of the skin in all animals. Warm and vapour baths, at temperatures varying from 100° to 120°, are ready and useful diaphoretics (p. 133).

Hydropathy affords a ready means of producing diaphoresis in the lower animals, as well as in man. The patient may be enveloped in a sheet saturated with cold water. Over this are placed three or four large horse-cloths. The legs should be subjected to similar treatment, or rolled in warm bandages. After the patient has been thus clothed for half-an-hour or an hour, he will steam and perspire very freely. The sheet and rugs should then be removed, and the animal dried by hand-rubbing, and comfortably clothed. This practice has been successfully adopted both with horses and cattle. Blood is thereby withdrawn from internal organs, healthy action is imparted to the skin, and beneficial reflex influences are exerted on internal parts. The evil effects of chills are thus counteracted, colds are cut short, and rheumatism, especially in gross subjects, removed. Hydropathic treatment should not, however, be adopted unless with due consideration, and under competent supervision. Protracted or violent diaphoresis, howsoever pro-

duced, proves debilitating. It removes from the body an undue proportion of its solids, and especially of its saline matters.

Diaphoretics **are used** for the following purposes :—

(1), They **restore checked cutaneous secretion,** and hence equalise irregularities of circulation, counteract congestion of internal organs, and lower exalted temperature. They are hence often serviceable in cutting short chills, colds, and simple febrile attacks, especially amongst horses.

(2) They **remove injurious waste products,** and other morbid matters which are apt to accumulate, particularly in febrile, inflammatory, and rheumatic disorders. These depurative services are especially valuable when the eliminating functions of the kidneys, bowels, or pulmonary membrane are impaired. In such cases the skin may be made to undertake a vicarious duty, and excrete waste matters usually disposed of by other channels.

Anhidrotics are drugs which **lessen cutaneous secretion.** Their effects appear to be induced (1), by diminishing the activity of the sweat glands ; (2), by lessening excitability of the sweat centres ; or (3), by acting on the circulation, usually by stimulating the respiratory centre, and thus overcoming that venous condition of the blood, which in weakness and disease is a frequent cause of sweating. It is in this last manner that belladonna and atropine, picrotoxine, jaborandi, ipecacuanha, nux vomica, and salts of zinc check sweating ; but belladonna and its alkaloid, moreover, are effective by their paralysing the terminals of the secreting nerves of the skin.

POISONS AND ANTIDOTES.

Antidotes are agents which **counteract the effects of poisons.** In the popular acceptation of the term, **a poison** is a drug, whether animal, vegetable, or mineral, which, in small quantity, destroys health and life; but it differs from a medicine only in the degree or intensity of its effects. Indeed many valuable medicines, when given injudiciously or in large doses, become active poisons, whilst many poisons, properly administered, prove valuable medicines.

Antidotes may prevent the action of the poison, or may

mitigate or arrest its effects. When a lethal dose has been swallowed, endeavours should be made, before it has time to enter the circulation, promptly to remove it by emetics, the stomach-pump, or stomach syphon. It is advisable, however, in all cases to empty the stomach, and thus remove unabsorbed portions of the poison, before giving any fluid which favours solution and absorption, or even before administering the antidote. Some antidotes, such as charcoal and demulcents, **mechanically envelope** the particles of the poison, or ensheath and protect the mucous surfaces. Many enter into **chemical combination** with the poison, forming comparatively insoluble inert compounds. Thus albumin forms with corrosive sublimate and other metallic salts, insoluble albuminates. Freshly precipitated iron per-oxide converts arsenious acid into the insoluble iron arseniate. Where poison has been introduced into a wound, as in the bite of a rabid dog, or the wound caused by a serpent, a ligature, if possible, is placed so as to prevent or retard absorption, and the wound is forthwith thoroughly washed with antiseptics and cauterised or excised.

The action of poisons, even after absorption, may moreover be controlled and counteracted by **remedies which antagonise** their lethal tendencies. Opium lessens the irritation and pain caused by irritants. Artificial respiration frequently sustains life throughout the stage of deadly narcosis induced by curare or prussic acid. But still **more definite antagonism** occurs between certain drugs. The stimulant and convulsant effects of strychnine on the spinal cord are opposed by chloral-hydrate, which lessens the excitability of the cord. The fatal depression of the respiratory centres, produced by large doses of aconite, is antagonised by alcohol, atropine, digitalin, and by strychnine. Between physostygmine and atropine, the antagonism is very marked in their actions on the vagus, on the heart, on muscular tissues, and on the iris, as well as on secretion. Two explanations are given of this antagonism. (1.) By chemical action, the drug first given is supposed to combine with the tissues immediately acted on, and to this combination the second drug may be added, developing another and less active compound; or, otherwise, from such compound the second drug may displace the first. (2.) The two antag-

onistic drugs may act independently of each other on the tissues, producing opposite effects—the one exciting, the other, it may be, paralysing. This latter physiological view seems to meet with most general approval (*Brunton*). In the case of poisons not rapidly fatal,—such as lead, mercury, savin, or yew,—an important curative measure consists in hastening their removal from the body by the organs through which they are chiefly excreted.

The following table, adapted from Dr Lauder Brunton's "Pharmacology, Therapeutics, and Materia Medica," presents some of the more common poisons and their antidotes :—

Poisonous Gases.

Sulphuretted Hydrogen	Chlorine cautiously inhaled.
Chlorine Bromine . . Iodine Vapour . .	Steam inhalation.
Ammonia Vapour . .	Vinegar vapour.
Carbon Monoxide . .	Fresh air and artificial respiration; transfusion.
Nitrous Oxide . .	Artificial respiration; tongue drawn forward; intermittent pressure over cardiac region if heart action failing.
Coal Gas . . . . Charcoal Fumes . . Carbonic Acid . . Marsh Gas . . . Fire-Damp . . .	Artificial respiration. Alternate warm and cold douches to the head and neck. Encourage circulation by friction. Mustard plasters over surface.

Acids.

Sulphuric Acid . . Hydrochloric Acid . Nitric Acid . . . Phosphoric Acid . .	Alkalies; sodium or potassium bicarbonate. Magnesia, chalk, plaster. Soap; milk; eggs whisked. Olive or almond oils.
Oxalic Acid and Oxalates . . . . Tartaric Acid . . . Acetic Acid . . .	Chalk, whiting, or plaster from the wall, with water.

Hydrocyanic Acid . Potassium Cyanide .	Alternate cold and warm affusions. Artificial respiration. Atropine injection, repeated every half-hour. Mixed proto and per salts of iron; magnesia.

Alkalies.

Potassium Oxide and Carbonate . Sodium Oxide and Carbonate . Ammonia Solution . Calcium Oxide .	Vinegar, lemon juice. Other dilute acids. Milk, oil.

Vegetable Drugs, Alkaloids, etc.

Aconite .	Spirits: Ammonia. Digitalis: atropine: warmth.
Acorns; Oak Shoots . Fern .	Oil: salines: laxative diet.
Alcohol .	Strong coffee, and Cold douches to the head.
Anæsthetics— Chloroform, ether, etc. .	Artificial respiration. Cold douche to head and neck.
Antimony .	In patients that do not vomit, wash out the stomach with tannic or gallic acids, followed by milk, white of egg, or other demulcents.
Arsenic .	Wash out stomach with large amount of warm water, introduced by stomach-pump. Give dogs zinc sulphate or other emetic. Iron-oxide, moist, made by precipitation of iron per-chloride solution by sodium-carbonate or ammonia.

Atropine— Belladonna Hyoscyamus Stramonium	Stimulants and coffee. Subcutaneous injection of caffeine. Keep the animal moving. Artificial respiration, if needful. Physostigma given cautiously.
Barium Salts	Epsom salt. Sulphuric acid diluted.
Calabar Bean— Physostigmine	Stimulants : chloral : Atropine, strychnine. Artificial respiration, if necessary.
Cantharides	Barley water, gruel, and other demulcents. Avoiding oils and fats.
Carbolic Acid Creosote	Saccharated lime : stimulants.
Chloral	Warmth. Keep patient moving. Strychnine and caffeine, subcutaneously.
Colchicum	Tannic and gallic acids : demulcents. Stimulants.
Conium : Coniïne— Cicuta Virosa Œnanthe Crocata	Tannic acid Strong coffee. Stimulants.
Croton Oil	Demulcents : stimulants.
Curare	Artificial respiration. If there be a wound, ligature, if possible, above it, and incise and suck strongly. Loosen ligature from time to time, but avoid letting too much poison into the blood at a time.
Digitalis— Digitalin	Tannin : stimulants. Aconite, subcutaneously. Perfect quiet.
Ergot	Tannin : stimulants.
Fungoid-infested, or mouldy fodder or grain	Substitute sound food: laxatives. Give eucalyptol, menthol, or other antiseptic volatile oils. Etherial stimulants. Sulpho-carbolates ; other saline antiseptics.

Gelsemium . . .	Atropine: stimulants. Artificial respiration.
Insects' Venomous Stings . . .	Apply ammonia and oil.
Laburnum . . .	Stimulants: coffee. Alternate hot and cold douches to chest.
Lobelia	Tannin: stimulants. Strychnine, hypodermically.
Lead Salts . . . *See also* Metallic Salts	Epsom salt: dilute sulphuric acid. Potassium iodide: occasional dose of castor-oil.
Metallic Salts, as of Copper, Lead, Mercury	White of egg, in large amount. Subsequently wash out stomach. Give demulcents. Fomentations: poultices. Morphine, if needful.
Morphine—Opium . . .	Empty stomach by pump or emetic. Warm coffee: ammonia. Arouse patient by keeping him moving, or by electric shocks. Atropine, subcutaneously. Artificial respiration, if needful.
Nitro-Benzol . . . Amyl-Nitrite . . .	Stimulants. Alternate hot and cold douche. Artificial respiration.
Nitro-Glycerin . .	Ergotin: atropine subcutaneously. Cold to head.
Phosphorus . . .	Copper sulphate. Oil of turpentine, old and oxidised. Avoid fats and oils.
Picrotoxine: Cocculus Indicus . . .	Chloral: Potassium-bromide.
Pilocarpine: Jaborandi	Atropine.
Quinine	Tannic or gallic acids: coffee. Stimulants: artificial respiration.
Savin	Epsom salt: demulcents: etherial stimulants.

Snake-Bite . . .	Ligature limb: excise wound, and sear with hot iron. Alcoholic stimulants: ammonia. Artificial respiration.
Strychnine: Brucine .	Chloroform: chloral.
Nux-Vomica . . .	Potassium-bromide: tannin.
Tobacco	Warm stimulants. Tannin: strychnine.
Turpentine Oil . .	Demulcents: Epsom salt.
Veratrine—White Hellebore .	Stimulants: warm coffee. Perfect quiet.
Yew	Stimulants: laxatives. Demulcents.

DOSES AND THEIR ADMINISTRATION.

The dose, channel of administration, and manner of using remedies demand consideration.

The dose, or quantity of the medicine used, affects the degree, and sometimes also the nature of the action produced. Thus small doses of most potassium, sodium, and magnesium salts, are alterative and diuretic, while larger quantities are purgative. Aloes, in small quantity, is tonic, and in large, purgative. Alcohol and opium are examples of medicines in which variation in dose produces difference in effect. With topical remedies, an increase of the time during which the drug is applied is generally equivalent to an increase of dose, as illustrated in the case of mustard, cantharides, and nitric acid.

The period during which a drug remains in the body determines in like manner its activity (p. 11). Hence increased action results from rapid absorption and prolonged retention within the body, while diminished action results from tardy absorption and quick excretion. Where continued effects are desired, as in the case of tonics or alteratives, small doses repeated three times daily are preferable to larger doses given at longer intervals. Stimulants, which are evanescent in their effects,—such as alcohol, ether, and ammonia,—are usually beneficially repeated every two or three hours, or, in critical cases, even oftener. The manner in which the patient is acted upon

by the dose chosen often determines its future regulation and repetition. The doses mentioned in this work under the head of each drug, unless otherwise stated, are those suitable for adult animals of medium size. But, as already indicated (p. 12), the size, weight, and environments of the patient require consideration in fixing the dose. In the lower animals, differences of sex do not materially affect dosage; although, on account of their larger size, extra doses are required for stallions, bulls, and rams. Doses must be adapted to the **age of the patient.** It is generally estimated that a one-year-old colt requires one-third the quantity of any medicine given to an adult horse; a two-year-old, one-half; a three-year-old, two-thirds. A somewhat similar ratio is applicable to cattle.

Medicines are used either for their **local** or **general actions,** or for a combination of both. In order to produce their general effects, medicines must be introduced into the body. This may be effected by injection into the veins or arteries,—which, however, is seldom done except experimentally,—or by absorption from serous membranes—a mode of administration rarely adopted. The three channels by which medicines are usually administered are:—

(1.) By the **digestive tract.**

(2.) By **inhalation** through the pulmonary mucous membrane.

(3.) By **absorption through the skin**—(*a*), epidermically, by inrubbing; (*b*), endermically, by removing the epidermis; (*c*), hypodermically, by injection into the subcutaneous cellular tissue.

The majority of medicines are **administered by the mouth,** either in a solid or fluid form. The fluid state favours rapid absorption, and secures quicker and more certain results, especially in cattle. Bland and non-irritant substances are usually given when the stomach contains a minimum of food, and when they are therefore likely to be promptly absorbed unchanged. Nutrient oils, iron salts, arsenic, and other irritants are, however, generally given along with food, or immediately after eating. The time, labour, and patience of attendants may sometimes be saved, and high-spirited nervous patients preserved from injurious struggling, if they can be persuaded to take their medicines voluntarily. This may some-

times be accomplished where comparatively concentrated, tasteless, or pleasant-tasted drugs are used, by mixing them with palatable food, or disguising them in gruel, milk, or even in water. Dogs and cats will often bolt concentrated drugs rolled up in a piece of meat. Although absorption is not nearly so active from the posterior portions of the digestive tract, soluble medicines introduced into the rectum gradually enter the circulation (p. 138).

The pulmonary mucous membrane has a superficies of fifty times the extent of the skin surfaces, is very actively absorbent, and is well adapted for conveying medicines into the system. This method of administration, now in familiar use with such agents as chloroform and ether, might be advantageously adopted in the case of active non-volatile medicines, which can be readily introduced into the lungs along with the vapour of water, or of such diffusible drugs as chloroform or ether. By this channel non-volatile medicines, in a finely-divided state, are thus quickly introduced into the blood without their activity being affected by contact with food or intestinal fluids, or by changes to which they may be subjected in their transit through the liver.

The skin is the medium by which many drugs are applied to the body, most of them—such as counter-irritants, caustics, and poultices—for the production of local effects, or for reflex actions exerted on adjacent or distant parts. The skin, protected by epidermis, although it absorbs oxygen and excretes carbonic acid, and takes up water from baths or from wet clothing, especially if there is a deficiency of fluid in the body, does not absorb drugs unless they are dissolved in chloroform or other agents which have a notable power of endosmosis, or unless they are well rubbed in, so that they shall be taken up by the sebaceous or perspiratory ducts. Neither alcoholic nor watery solutions of drugs are absorbed through the unbroken skin. This is illustrated by the impunity with which arsenical dips are used even when of five times the ordinary strength, and when the sheep are kept in them for several minutes.

When the epidermis, however, is removed by a blister, the true skin readily absorbs drugs placed on it. By this **endermic method,** morphine was wont to be used for the production of

its general anodyne effects, but the hypodermic method is more convenient, and is now generally preferred.

The hypodermic administration of drugs consists in their injection in solution into the subcutaneous cellular tissue, or occasionally into the substance of a muscle. They thus enter the blood-stream unaltered .by contact with the contents or secretions of the digestive canal. They escape the changes which many substances undergo in the liver, and hence act more certainly and rapidly. Hypodermic injection is specially indicated—

(1.) Where rapid energetic effects are required, as in poisoning, internal hæmorrhage, threatening collapse, paroxysms of acute pain, and convulsions.

(2.) Where local and general effects are desired to be conjoined, as in reflex spasms.

(3.) Where internal administration is difficult or impossible.

The drugs thus used should be non-irritant, and soluble in water or glycerin. Many veterinarians now use morphine, atropine, ergotin, and other active drugs hypodermically for arresting or controlling the spasms of colic and chronic cough, the sharp twinges of rheumatism, the inflammatory pain of enteritis and pleurisy, as well as for combating the effects of poisons. Where pain is to be counteracted, the injection is made near the affected spot, or over the nerve which is believed to be conveying the disordered impression. With active agents it is unwise, without careful trial, subcutaneously to inject more than one-fourth of the dose which would be given by the mouth. The drug is thoroughly dissolved in water, or other perfectly bland fluid; two to four drachms of solution is sufficient for one injection for horses or cattle, and proportionately smaller amounts for sheep and dogs; there is less risk than in human subjects of subsequent topical irritation.

The hypodermic syringe has a glass barrel, on the nozzle of which a hollow needle is fitted. It is essential that the syringe be kept perfectly clean, and the needle, when put away, should have a drop of oil drawn into it, in order to prevent rusting, while a slender capillary wire is generally kept in it; its point must be kept sharp. The operation is of the simplest description. Choice is generally made of a situation

where the skin is thin, and the subcutaneous tissue loose, as behind the elbow, or at the lower part of the neck. A fold of loose skin is taken up between the finger and thumb of the left hand ; the needle, detached from the syringe, is passed through the skin, and carried about an inch obliquely under, and parallel with the surface. The nozzle of the filled syringe is then screwed on to the needle, the piston slowly pushed home, and the instrument cautiously withdrawn. The puncture requires no plaster or dressing. A ready, but less prompt or certain, substitute for hypodermic injection, consists in coating a thread with a strong solution of the active principle to be introduced, and drawing this medicated seton through the skin.

SECTION II.

VETERINARY PHARMACY.

THIS section presents a brief notice of the art of prescribing, and of such important officinal preparations and curative appliances as alkaloids, baths, boluses, drenches, tinctures, etc., arranged for convenience of reference in alphabetical order, according to their English names; while appended are the tables of the Pharmacopœia, and of metric weights and measures.

THE ART OF PRESCRIBING.

Successful prescribing obviously necessitates a competent knowledge of the chemical and physiological actions of the drugs used. Those only can be properly conjoined which are chemically and physiologically suitable. Text-books sometimes present lists of medicines which may fittingly be used together under the title of **synergists**; while lists are given of substances **chemically incompatible** or **physiologically antagonistic.** The prescription should be as brief and simple as possible. Two separate prescriptions are preferable to one that is lengthy or contains incongruous materials. The solubility and consequent ready absorption of the drugs employed demand the primary attention of the prescriber. Preference should generally be given to the more soluble salts or preparations of the drug. Insoluble or slightly soluble medicines are conjoined with some suitable solvent. Thus arsenic is adminstered in alkaline solution; quinine, with a dilute acid; iodine, with potassium iodide. **Adjuvants** are sometimes introduced in order to increase, moderate, or modify the action of the principal constituent or basis. Thus a few grains of calomel are added to the purgative jalap pill for the dog; several drops of croton oil are given with the linseed oil, or salts and treacle used in obstinate constipation in cattle; a small dose of laudanum is prescribed with oil in cases of diarrhœa; ginger is generally

added as a carminative to the aloetic mass for horses. More prompt and certain results are sometimes obtained by the combination of two medicines producing their effects in somewhat different ways. Thus spasms of the bowels are often more effectually controlled by the conjunction of a stimulant like ether and an anodyne such as opium than by either given alone. Pain which is not alleviated by either morphine or atropine is sometimes abated by giving them together.

The prescriber's aphorism, "*Curare cito tute et jocunde,*" is more easily fulfilled now than formerly. With a widening choice of carefully prepared drugs, the effects of which are becoming better known, the practitioner is better able to cure quickly, safely, and pleasantly. The art of prescribing has, moreover, been facilitated. The British and other Pharmacopœias present a number of approved combinations suitable for most purposes, thus saving the practitioner the elaboration or making up of prescriptions. Instead of crude vegetable drugs, often inconveniently bulky, and containing useless and even injurious constituents, extracts and tinctures have long been used. But concentration and simplification are being carried still further. Alkaloids and other active principles are separated, and possess the advantage not only of concentrated form, but usually also of more uniform quality and less liability to spoil.

To guard against impurities and adulterations, the *British Pharmacopœia*, under the head of each drug, gives characters and tests which enable purchasers to satisfy themselves of the quality and purity of the articles used. Many of these carefully-verified characters and tests, given in the *British Pharmacopœia* edition for 1885, have been introduced into this work.

ALKALOIDS.

These **alkali-like organic bases** are found in various plants, some of which, like the opium poppy, cinchona bark, and jaborandi, contain more than one alkaloid. They probably result from the metamorphosis of albuminoid plant constituents. They are generally powerful poisons or active medicines. Sixteen are enumerated in the *British Pharmacopœia.* Those

chiefly used are morphine, atropine, quinine, cocaine, pilocarpine, and ergotinine. Similar alkaloids, allied to xanthin and kreatin, are produced from the natural decomposition of proteid compounds in the bodies of living animals by the action of such unorganised ferments as pepsin, and have been termed **leucomaïnes.** Another series, such as neurine, cadaverine, putrescine, and mydaleine, formed by the action of bacteria in the bodies of animals, receive the title of **ptomaïnes** (p. 26). Free access of air favours the development of these alkaloids in decomposing animal substances. Those resulting in the more advanced stages of putrefaction are most poisonous. Brieger, by acting on beef with a microbe, from traumatic tetanus in man, has evolved an alkaloid which he calls tetanine, which causes tetanus in all animals. From putrefying brain, and from the bodies of persons dying from typhus fever, deadly alkaloids have been obtained. A few of these organic bases, such as atropine and coniïne, have been prepared synthetically.

Most alkaloids contain the four organic elements; **all contain nitrogen.** But although the molecule may contain twenty or thirty carbon or hydrogen atoms, there are seldom more than two atoms of nitrogen. They are generally crystallisable solids. Three of the natural alkaloids, coniïne, nicotine, and sparteine, contain, however, no oxygen, and are volatile liquids. Alkaloids are **ammonia derivatives,** but their sparing solubility in water renders it unlikely that they are ammonium bases; their not subliming without some decomposition distinguishes them from the amines; their feebly basic character and other properties more nearly **ally them with the amides** (*Bloxam*). They may otherwise be defined as **substituted ammonias,** capable of forming salts by direct addition of acids. Many are closely related to pyridin. Most are soluble in alcohol, ether, benzin, and carbon disulphide, and usually in chloroform, which does not, however, dissolve morphine or solanine. Most are insoluble in water, which, however, readily dissolves brucine and codeine. Alkaloids readily unite with acids, forming salts, soluble in water; and with radicles such as ethyl and methyl, forming combinations which greatly modify their actions, as is strikingly illustrated in the difference between coniïne and methyl-coniïne (p. 5). Their chemical composition affords no

clue to their physiological action. Those of diverse composition have sometimes similar actions; those apparently of like composition differ in their actions. Between the anodyne soporific, morphine, and the emetic apomorphine, the formulæ show a difference of only two atoms of hydrogen. Alkaloids are often associated in plants with some special acid, in combination with which, or with a diluted acid added to the plant juices, they are dissolved out, usually by water, and from such solution the alkaloid may be precipitated by ammonia.

The alkaloids are now generally given the termination "ine" —as morphine, strychnine, etc.,—although in some works the termination "ia" is still adhered to. The neutral principles, such as aloin, santonin, salicin, have the terminal "in."

BATHS.

Baths are important, alike for the preservation of health and for the cure of disease amongst the domestic animals. They are used in various ways, at different temperatures, and for the treatment of various medical and some surgical cases.

Cold baths are of a lower temperature than 70° Fahr. Judiciously used, they exert tonic, bracing, or stimulating effects. They contract cutaneous vessels, promote tissue change, and increase excretion of waste products. When the cold is too long applied, especially in young or delicate animals, chill, shivering, and even more injurious effects may follow. Owing to its saline ingredients, and the constant movement of the waves, a sea bath is more exhilarating than fresh water at rest. Healthful reaction is encouraged by thorough drying, hand-rubbing, clothing, and, if need be, by subsequent administration of stimulants. Cold baths are sometimes used for reducing excessive temperature. The patient may be placed in water at 70° Fahr., and the temperature reduced to 60°, or even lower; or he may be placed at once in a bath of 60° to 50°; or he may have cold water dashed over him. In such cases the patient is kept in the bath for ten or fifteen minutes, and such treatment may be repeated twice daily. By such means excessive temperature may be reduced from 1° to 4°, and with lowered temperature excessive and dangerous tissue-change is moderated.

Tepid baths range from 65° to 85° Fahr. They cleanse the skin, promote perspiration, allay thirst, and are grateful to heated and overtaxed horses. They are useful not only in promoting comfort, but in removing stiffness alike in horses and dogs after a hard day's work.

Warm baths range from 85° to 97° Fahr. They soften the epidermis, and hence relieve erythematous and chronic skin disorders. They dilate cutaneous vessels, promote perspiration, and thus antagonise internal congestion. It is forty years since Professor John Gamgee, in the *Domestic Animals in Health and Disease*, thus testified to the benefit of warm baths: "I unhesitatingly say that we have in the thermæ the most effectual diaphoretic, the most active depurant, and the most effectual means of inducing a healthy reaction that we have yet had at our disposal. It is a great addition to our therapeutic means. We needed a satisfactory means of acting on the skin of the lower animals in febrile and other diseases, and we here have it."

Hot baths range from 97° upwards, and, if the temperature be gradually increased, may be raised to 110° Fahr. Hot baths elevate the temperature of the body, quicken the pulse and respiration, dilate the skin capillaries, and hasten excretion of waste. They soothe animals which have been subjected to severe muscular exertion, relieve cramps and colic, benefit chronic skin disorders, and check catarrh, rheumatism, and attacks of weed.

Baths are sometimes **medicated.** Salt or mustard is added to increase skin stimulation; alkaline carbonates or potassium sulphuret are used in some chronic skin disorders; solution of arsenious acid, tobacco juice, carbolic acid, and other antiseptics are introduced when skin parasites are to be destroyed.

Neither **Turkish** nor **vapour, steam,** or **Russian** baths are employed for the lower animals in the systematic manner in which they are used by mankind; but many trainers', some large job-masters', a few gentlemen's and some veterinarians' stables have capital washrooms provided with steam, hot and cold water-pipes, where horses after severe exertion are conveniently washed and dressed; where chronic coughs, chills, rheumatism, dyspepsia, and other ailments are hydropathically

treated; and where sprains and enlarged joints can be successfully douched.

Without expensive or special appliances, many of the sanitary and curative advantages of baths can readily be secured by **sponging horses,** as their condition or ailment suggests, with tepid, hot, or cold water. Cleansing, tonic, or antipyretic effects may thus be readily obtained. Irritating or noxious matters are removed from the skin, circulation is equalised, excessive temperature reduced. In febrile cases, whether in horses or cattle, the temperature of the water used should not at first be lower than 85° or 80° Fahr. A little acid may be advantageously added. The sponging should not occupy more than three or four minutes. The animal should be wisped dry and immediately clothed. Within three or four hours the operation, if necessary, may be repeated, especially if the temperature reduced by the first sponging again rises. After the first or second sponging, water at 65° or 60° Fahr. may be used. Concurrently with such treatment, antiseptic salines or stimulants may be prescribed. In chorea, especially in tolerably vigorous and short-haired dogs, sponging with cold water is serviceable. Enveloping the patient in a sheet wetted with either tepid or cold water, and covering with two or three blankets, constituting what is entitled the wet pack, is not generally so serviceable in veterinary practice as either sponging or the bath (p. 117).

BALLS—BOLUSES—PILULAE.

Balls correspond in veterinary practice with the **pills** used in human medicine. Extracts are conveniently moulded into cylindrical balls. Drugs in powder or concentrated solution are made into mass or bolus with such **excipients** as linseed meal and water, oil, lard, soap, mucilage, liquorice, and powdered gentian, treacle, syrup, glycerin, vaselin, and conserve of roses, the choice being determined by the nature of the active ingredients. The five excipients first mentioned are chiefly used when the bolus or mass is intended for immediate use; when it is to be kept for any considerable time, some of

the others are more suitable. To keep a mass in its desirable moist, soft-solid state, it is often advisable to add to it a small quantity of such a deliquescent alkaline salt as potassium acetate, which serves especially well for most diuretic masses. When the active principles are resinous, a little alcohol or oil of turpentine is a useful addition, as in making aloetic masses.

In preparing a ball mass, the various ingredients are sometimes mixed together in a mortar or on a slab; but when the materials are waxy or resinous, the aid of heat is usually necessary. A good ball mass must be soft, and yet possessed of proper consistence and cohesion, must retain these properties although kept for a considerable time, and must further be prepared so that each dose shall make a proper sized ball, which for the horse should weigh from one to two ounces. The ball mass should be preserved in jars covered with moistened bladder and stout paper, and be made into doses only as required; for when balls are long kept they are apt to get hard, and in this state act tardily and uncertainly, sometimes passing through the alimentary canal unchanged. To prevent spoiling, as well as for cleanliness and facility of administration, balls are given either rolled up in soft paper or are coated with kreatin, with a solution of one part of gelatin and twenty of water, or with an etherial solution of tulu.

For horses the bolus is a common and handy method of administration; for dogs it is also often used. It is given to horses either with the balling-iron or with the fingers; and the latter method is preferable, except in animals with small, narrow mouths, or in which the mouth cannot be sufficiently opened. The operation, with a little practice and dexterity, is easily performed. The ball is held by one end between the thumb (which supports it below) and the fingers of the right hand, which is drawn together and rounded as much as possible. The patient's tongue is gently drawn out a little way by the left hand, and the ball passed rapidly along the roof of the mouth, and dropped on the back of the tongue, which is at once let loose, the mouth closed, and the head kept slightly elevated for a couple of minutes. Dogs generally bolt their pills if they are deftly rolled in a piece of meat.

DECOCTIONS.

Decoctions are solutions prepared by **boiling the drug in water.** To insure perfect solution, the substance is bruised or cut into small pieces, and occasionally undergoes preliminary digestion. The process is conducted in glass or earthenware vessels, and boiling prolonged beyond twenty minutes is carefully guarded against. Any insoluble residue is subsequently separated by filtering through bibulous or unsized paper, straining through muslin or calico, or allowing time to settle, and pouring off the supernatant fluid. Decoctions, when intended to be kept beyond a week or two, should have a little spirit added, and be bottled and well corked while hot. Without these precautions they are apt to ferment, or otherwise become spoilt. The B. P. gives directions for making decoctions of aloes, cinchona, poppies, oak bark, and nine others less used by veterinarians.

DRAUGHTS—DRENCHES—DRINKS.

Drenches are generally **extemporaneous fluid preparations** used in a single dose. Bulky substances which cannot be administered in bolus are necessarily given in draught. They are prescribed for horses and dogs, especially when a speedy effect is desired, as in colic, and are almost the only form in which physic is given to cattle or sheep. In these ruminants, medicines in the solid state get mixed with the immense bulk of food always found in the rumen, remain unabsorbed often for a long time, and thus act tardily and imperfectly. Medicines in liquid form, however, come more immediately into intimate contact with absorbing mucous surfaces, and pass on more speedily towards the second and fourth stomachs. Saline febrifuge and tonic draughts, made fairly palatable, are often readily taken by patients in gruel or water, without the trouble of forcible administration.

In preparing drenches, care must be taken that the several ingredients are not incompatible, decomposing or injuriously reacting on each other; and further, that their quantity be not so great as unnecessarily to increase the trouble of administra-

tion. For dogs, from two to six ounces, according to the size of the animal, is an average amount; for horses, one or two pints; for sheep, from six to eight ounces; but for cattle it is not so necessary to limit the proportion of fluid. Before being given, drenches ought to be thoroughly mixed, and well shaken, in order to prevent ammonia, turpentine, or other light constituents floating to the surface, or heavy partially-dissolved substances remaining at the bottom.

In giving drenches, the head should be slightly raised, which in horses is conveniently done with the aid of a twitch, the noose of which is placed over the animal's upper jaw within the incisor teeth, and the stick held by an assistant, standing on the left side of the patient. In cattle, the head should be steadied by an assistant, who holds either the horns or ears. In dogs, the jaws may be kept sufficiently apart by an assistant placing a loop of stout tape or string, or a towel folded repeatedly, over each jaw, and gently separating them, when the medicine is readily poured over. Small dogs are most conveniently dosed when placed on their hind-quarters on a table or bench; but larger dogs should be backed into a corner, and their head held between the operator's knees. Cats get their physic without doing damage with their claws if dropped into a capacious top-boot, the head being left out, and the jaws held apart with a couple of pieces of tape. In all animals, the nostrils must be left unobstructed, and the tongue loose, or only gently held down, so as to prevent its interfering with the medicine passing from the bottle. Drenches should be carefully and slowly given; and if coughing occurs, the operation should be stopped, and the animal set free for a few minutes.

Glass bottles, generally used for the administration of drenches, have the disadvantage of being fragile, and, when they break, waste the medicine, and may besides injure the mouth of the patient, or the hands of the operator. Veterinarians, and even agriculturists, should therefore have stout **tin bottles** of two sizes, capable of holding a pint and a quart, made either round or flat—the latter more convenient for the pocket—and closed by a cap screwed on the nozzle. The old-fashioned horn requires practice to use it without spilling its contents, and is now generally superseded by the metallic bottle.

ENEMAS—ENEMATA—CLYSTERS—SUPPOSITORIES —INJECTIONS.

Enemas are liquid injections into the rectum, and are employed to effect several useful purposes. They empty the lower bowel when it may be undesirable to excite other parts of the intestine. They accelerate, increase, and maintain the action of purgatives. They destroy and remove worms infesting the posterior part of the canal. They may exert soothing as well as stimulating effects; and reflexly, such effects may be propagated to adjacent and even to remote organs. They besides prove convenient vehicles for introducing into the body food and medicines, which in sore throat, tetanus, apoplexy, or other cases, cannot readily be swallowed, and which are absorbed, although not nearly so rapidly as from the duodenum.

Whether in health or disease, no remedies are so safe and effectual for maintaining the regular action of the bowels, and when properly used they sometimes supersede the necessity for purgatives. In constipation and torpidity, after hardened, impacted, obstructing fæcal masses are broken down and removed, according to the species of patient, by the hand, finger, or small spatula, laxative enemata are advantageously injected, intermitting the operation whenever straining occurs, raising the hind parts, and by external pressure from behind increasing the retaining capacity of the sphincter. A gallon and a half to five gallons of tepid water may thus be slowly introduced into the rectum of a draught horse; a pint into the rectum of a dog 40 lbs. weight. When the posterior gut is thus distended, not only is mechanical facility given for the outward movement of the contents of the canal, but by reflex action peristalsis is encouraged far beyond actual contact of the injected fluid. The effects of the tepid water are increased by the addition of soap, bland oil, salines, oil of turpentine, or solution of aloes. These copious injections, alternated with tobacco-smoke enemata, and the administration of full doses of opium, Indian hemp, and atropine, relieve intestinal spasm, and prove the chief treatment for cases of invagination and strangulation of the intestines, whether in horses or dogs.

Many cases of **obstinate torpidity of the bowels** in horses, depending on impaction of dry food or fæces, or from earthy deposits in the colon, may be relieved or removed by the free use of enemata introduced into the large intestines by a special apparatus. Mr Frederick Smith of the Army Veterinary School, Aldershot, has devised and successfully used such an apparatus, which he described at the Peterborough meeting of the National Veterinary Association in 1887, as consisting of six feet of elastic tubing, of the same calibre as that of the Reid enema tubing, on to which it is screwed. It is provided with a rounded nozzle, with side perforations. The tubing can be passed into the single, perhaps into the double, colon of the horse. Any difficulty in introducing it is overcome not by force, but by injection of a gallon of water, which, dilating the bowel in advance, facilitates further passage of the tube. Mr Smith, in such cases, throws up from five to fifteen gallons generally of cold water; has in some cases injected at a time as much as twenty-seven gallons; and repeats the enema at intervals of three or four hours. Unlike enemata discharged into the rectum, these large amounts of fluid are in great part retained with the effect of softening and mechanically bringing away most obstructions.

Tolerably copious clysters of tepid water or other bland fluid exert local soothing effects, not only on the intestines, but also reflexly allay irritability, spasm, and pain of the urino-genital organs, and frequently relieve suppression of urine. Their efficacy is sometimes increased by addition of opium and other sedatives, which are used in about the same doses as are given by the mouth. By reflex action the kidneys, bladder, and uterus, are also sometimes beneficially acted upon by stimulant enemata. For destroying and dislodging the oxyuris curvula, popularly known as ascarides, clysters of turpentine and lime water, and of solution of aloes, quassia, or iron chloride, are effectual. In house dogs, troubled with constipation and hæmorrhoids, the cautious daily injection of two or three ounces of cold water proves serviceable.

When intended to be retained or absorbed, enemas should be limited in amount; one to two pints suffice for horses, three to four ounces for dogs weighing 20 lbs. To allay irritation

and spasm in troublesome diarrhœa and dysentery, vegetable astringents, opium, and lead acetate, are given usually with well-boiled tepid starch gruel. In such cases the injection may be repeated every hour or two, so long as straining or diarrhœa continue. Nutrient clysters, useful in tetanus, sore throat, and debilitating complaints, when patients will not or cannot eat, usually consist of linseed tea, with milk and eggs, or of strong beef-tea introduced at a temperature of 100°, and repeated not oftener than four or five times in the twenty-four hours. In cases of influenza in horses and distemper in dogs, a little wine or whisky is sometimes added to the nutrient clyster.

The apparatus for giving enemata are—the old-fashioned bladder tied on a piece of lead pipe; Reid's patent clyster syringe, improved by Mr Arnold, which is also available as a stomach-pump; the far-reaching Reid's apparatus, with six feet of extra tubing, above described; Mr Gamgee's block-tin tube and funnel, which fill the rectum by gravitation, and obviate the necessity of pumping; and the common barrel-syringe, of which the best are made of copper tinned over, with a nozzle which screws out at pleasure, and can be carried in the interior of the instrument. In the horse the rectum is generally cleared by the hand before any of these articles are used; and in all animals the part of the apparatus which enters the gut should be smeared with lard or oil, and introduced slowly and carefully.

Suppositories of raw or cooked meat are readily absorbed from the rectum, especially if they are previously moistened with diluted hydrochloric acid and pepsin. Drugs in the form of suppositories, usually made up with cocoa-butter, are occasionally introduced into the rectum vagina and uterus. A cylinder of soap introduced within the anus, and held for a minute or two, conveniently encourages the action of the bowels, especially in dogs and cats, and in young foals and calves.

Injections are made into the nostrils, urethra, bladder, and uterus, as also into the trachea, for the destruction of bronchial filaria. Hypodermic injections have already been noticed (p. 127). Medicated spray thrown from a caoutchouc ball and

tube, or from a steam spray-producer, is frequently used for irrigating irritable, relaxed, or diphtheritic throats, especially in horses (p. 59).

EXTRACTS—FLUID EXTRACTS—FRESH OR GREEN EXTRACTS—ABSTRACTS—SUCCI.

Extracts consist of the **soluble, active principles** of plants **reduced to a semi-solid paste** by evaporation of the natural expressed juices, or of decoctions, infusions, or tinctures. Selection is made of the solvent—whether water, rectified or proof spirit, or occasionally ether—which most readily removes the active principles. Where two active principles, soluble in different media, are to be dissolved out, the drug is acted upon by the two solvents in succession, and the solutions mixed and evaporated. It is important that evaporation be effected at low temperatures; those above 150° Fahr. are apt to injure or decompose many active principles. Well-made extracts keep for a considerable time without change, especially in a cool, dry place, and if occasionally moistened with rectified spirit; but when twelve months old they should be regarded with suspicion. Of the thirty-four B. P. extracts, veterinarians chiefly use those of belladonna, hemlock, and Indian hemp.

The liquid B. P. extracts number thirteen. The corresponding U. S. Phar. **fluid** extracts number seventy-nine. They are prepared from infusions, decoctions, or weak tinctures, in the same manner as the semi-solid extracts. Being less concentrated they are not so strong, and require the addition of spirit to ensure their keeping. Those chiefly used in veterinary practice are liquid extract of cinchona, ergot, male shield fern, and opium.

Green or fresh extracts are prepared from fresh plants, the leaves and tender stems being generally preferred. They are bruised, the juice expressed, and gently heated to about 120° to 130° Fahr. The green colouring matter is separated by filtration, the strained juice is heated to 200° to coagulate albumin, again filtered, and the filtrate evaporated in a water bath to the consistence of a thin syrup. The green colouring matter previously separated is then added, and evaporation

continued with stirring at a temperature not exceeding 140° Fahr., until a suitable consistence is attained.

Abstracts are **concentrated extracts,** about twice the strength of the corresponding fluid extract, and occur in dry powders mixed with milk-sugar. Eleven of those figure in the U. S. Phar., including those of aconite, belladonna, hemlock, and digitalis.

The succi or **expressed juices** of belladonna, hemlock, henbane, and taraxacum, by instruction of the B. P., are preserved by digestion for seven days, with one-third of their bulk of rectified spirit, and filtering.

FOMENTATIONS.

Fomentations are **topical baths,** usually consist of water alone, but vinegar, saline, and other substances are sometimes added. Unless otherwise specified, they are applied hot. The temperature at which they are used must be determined by the purpose to be served, by the nature and extent of the malady, and the part of the body to which they are applied. For the eye, they should not exceed 100° F.; for contusions, boils, strains, and weed, they should be as hot as the hand can bear. Up to 110° F. they generally soften and soothe. At higher temperatures they irritate. To produce active counter-irritation, as in bronchitis, pleurisy, or enteritis, they are used at temperatures ranging from 120° upwards. For such cases, pieces of flannel or horse-cloths are saturated with boiling water, are partially dried by a wringer, or by being rolled and pressed between dry coarse towels, and are laid over a considerable extent of surface contiguous to the parts affected. The hot wet woollen article should be covered with oil-skin or a piece of mackintosh to retard evaporation and cooling. The pained part to be soothed, or the surface to be stimulated, is sometimes covered with several folds of woollen stuffs, amongst which water of the fitting temperature is poured at short intervals. Jets of steam mixed with air, to prevent their scalding, and used either plain or medicated, may be substituted for the ordinary stuping with water. Fomentations are generally made with a sponge or soft piece of rag, tow, or lint.

When there are foul discharges, sponges should be interdicted, as they are apt to retain and convey putrefactive germs, while the piece of lint or tow is thrown away as soon as done with.

Fomentations are **used** mechanically to cleanse wounds and soften hard skin or encrusted discharges. They relax and soothe irritated, congested, inflamed parts to which they are applied, and thus lessen tension and pain (p. 72). When freely employed for some considerable time, they moreover dilate the capillaries of collateral areas of circulation, withdrawing blood from adjacent inflamed parts, and thus acting as counter-irritants (p. 65.)

Their chief disadvantages, as ordinarily used, are their being withdrawn before their heat and moisture have time to do much good, and their causing subsequent rapid cooling. To obtain their full benefits, they should be continued during several hours; fresh supplies of water, of the requisite temperature, being had in abundance. After the operation is finished, the parts should be dried and well clothed, in order to prevent the rapid diminution of temperature which otherwise ensues from evaporation. Further, to prevent chilling, the fomented surfaces are sometimes stimulated by a gentle warming with mustard paste.

Heat applied to the spine usually in the form of the hot-water bag at a temperature of 120°, as shown by Dr Chapman, stimulates the cord and sympathetic ganglia, contracts involuntary muscular fibres of arterioles, and thus lessens the volume and rapidity of blood passing through them. The spinal hot-bag is hence used to arrest hæmorrhage.

On the other hand, **the ice-bag applied to the spine** is a sedative to the cord and nerve-centres brought under its paralysing influences, and hence lowers muscular tone, sensibility, and secretion. Applied in the cervical region, it increases afflux of blood to the head; applied over the anterior dorsal region, blood is driven to the chest and anterior extremities; applied over the posterior dorsal and lumbar regions, blood is moved in larger amount through the abdominal and pelvic organs, and the posterior extremities. Acting upon the spinal and sympathetic centres, the ice-bag controls remote morbid processes; cramps and spasms, even of tetanus, are stated to

be abated; pains of neuralgia and rheumatism are sometimes arrested; while inordinate discharges, and even hæmorrhages from the lungs, bowels, or kidneys, are sometimes checked (Ringer's *Therapeutics*).

GLYCERINES.

Glycerines are solutions of soothing astringent or antiseptic substances in glycerin. They are applied locally to the skin and mucous surfaces. Those of carbolic, gallic, and tannic acids contain one ounce by weight of the acid, mixed and gently heated with four fluid ounces of glycerin. Glycerin of borax contains, besides the one of acid and four of the solvent, two of distilled water. Glycerin of starch is made with one ounce by weight of starch, five fluid ounces of glycerin, and three of water. Glycerines of lead subacetate and of tragacanth are also occasionally used.

INFUSIONS.

Infusions are solutions prepared by **digesting vegetable substances in hot water.** Nearly all the twenty-eight officinal infusions are made by pouring boiling water on the powdered or cut drug, usually in the proportion of one part to twenty of water. The process is generally conducted in stoneware jars or jugs, provided with a cup having perforated sides and bottom, fitting into the top of the jug, extending about half-way down, and containing the solid matters to be infused. Digestion is effected on a stove, is continued for periods ranging from fifteen minutes to two hours; boiling is avoided. The infusion, when cool, is generally strained, but for veterinary purposes and for immediate use decanting is often sufficient. Unless carefully bottled and corked, while hot, infusions soon spoil, especially in warm weather. Their keeping is sometimes improved by concentration, by evaporation, or by addition of alcohol. *Examples*—Infusion of catechu, gentian, ergot, and valerian.

LIQUORS—SOLUTIONS—LOTIONS.

The Brit. Phar. enumerates forty-eight **liquores** or solutions, nearly all containing inorganic bodies or alkaloids, dissolved in water alone, or with other solvents. They vary greatly in strength and dose. Those containing arsenic, atropine, morphine, and strychnine, have $4\frac{1}{2}$ grains of the poison to the fluid ounce, or 1 part to 100. The liquors chiefly used by veterinarians are liquor ammoniæ, liquor ammonii acetatis, or Mindererus spirit, liquor arsenicalis, liquor ferri perchloridi, liquor potassæ, and liquor calcis. Solutions of extra strength for hypodermic injection are now included in the Brit. Phar.

Lotions are watery solutions intended for external use. Those for the eye are usually called **collyria.**

MIXTURES—MUCILAGES—EMULSIONS.

Mixtures or misturæ are preparations usually containing insoluble drugs suspended in mucilage or other viscid substances. They are exemplified by camphor chalk and catechu mixtures. Insoluble, heavy powders, mixed with dissolved gum or starch, are sometimes also termed **mucilages.**

Emulsions are opalescent mixtures of oil or resin, suspended in gum, soap, alkali, or white of egg.

OILS, FIXED AND VOLATILE.

Fixed oils and fats occur in many plants, usually in the seeds or fleshy pulp, frequently associated with mucilage, and are also present in animal bodies. Besides almond, olive, castor, croton, cocoa-nut, and cod-liver oils, enumerated in the Brit. Phar., lard, linseed, palm, and cotton-seed oil are also used in veterinary practice. The fixed oils are obtained by expression. They consist of two or more fatty acids—oleic, margaric, palmitic, and stearic—in combination with the sweet basic principle glycerin. They contain 76-79 parts of carbon, with 11-13 of hydrogen, and 10-12 of oxygen. Their consistence varies according to the proportion of the fluid olein. When fresh, they are generally almost colourless, and are in-

odorous and tasteless. When exposed to the air, the traces of albuminoids which they contain oxidise, a species of fermentation ensues, as in saponification, resulting in the breaking up of the neutral fatty matters, with the production of disagreeable rancidity, which may however be removed by boiling the faulty oil with water, and subsequently washing it with a weak soda solution. Oils and water are mutually but very slightly soluble, but oils and fats are readily dissolved by carbon disulphide, benzin, oil of turpentine, ether, and chloroform. They are miscible, and hence sometimes conveniently administered, in milk. Castor and croton oils are soluble in cold alcohol. They vary in their combustibility and their melting and freezing points. Their specific gravity ranges from 900-970. The bland oils—such as olive, linseed, palm, and cod-liver—in small quantities are **nutrients,** but administered in larger amount they are **purgatives.** Croton oil is irritant, whether applied to the mucous surfaces or to the skin.

The volatile or essential oils are mostly of vegetable origin, being found generally in the flowers, leaves, fruit, or seeds of plants, but they occur in all parts of the coniferæ. Most are found ready formed, but some, as the hydrocyanated, almond, and mustard oils, are produced by a species of fermentation. The B. P. details twenty-five volatile oils of vegetable origin, and the several volatile animal odorous principles—ambergris, from the sperm whale, civet, musk, and castor are occasionally used. The chemical constitution of the volatile oils differs from that of the fixed oils; most are pure hydro-carbons, with the molecular formula of oil of turpentine (C_{10} H_{16}), and are termed terpenes. With this terpene is generally associated an oxidised product, analogous to the colophony or resin (C_{20} H_{30} O_2) of turpentine. Some, such as oil of garlic, contain sulphur (C_6 H_{10} S). They produce no permanent grease stain. Unlike the fat oils, they are not unctuous, but make the skin rough or brittle. They are mostly colourless, but have a powerful odour, and distinctive—often aromatic—taste. They are insoluble, or only slightly soluble, in water, but are readily soluble in alcohol, ether, fatty and mineral oils. They are mostly lighter than water. Most boil between 302-382° Fahr., but the boiling point of camphors is about 372° F. All are

acted upon by oxygen, and distil unchanged. They are prepared in several ways: (1), by expression; (2), distillation; (3), extraction with solvents at ordinary temperatures, with or without pressure; (4), maceration or infusion; (5), absorption, with the use of hot air. The volatile oils are mostly **antiseptics** and **stimulants,** and are used as carminatives and antispasmodics.

The camphors appear to be the oxides of volatile hydrocarbons. Common camphor has the formula $C_{10} H_{16} O$. In physiological action they are allied to the volatile oils.

Oleo-resins, such as crude turpentine, and oleo-resina cubebæ, are mixtures of volatile oil and colophony or resin.

Balsams are vegetable exudations, consisting of resins and acids dissolved in volatile oils.

OINTMENTS—OLEATES—LINIMENTS—CERATES.

Ointments or **unguenta** are **mixtures of drugs with fatty matters,** are of the consistence of butter, and are used externally. The excipients generally employed are lard and oils; greater consistence and adhesion are conferred by addition of wax and resin; rancidity is checked by admixture of benzoin, or by substituting for the animal or vegetable oils such mineral oils as paraffin or vaselin. By using lanolin or oleic acid as the basis, absorption through the skin is facilitated. When lard or oil are the excipients, the ointment may generally be prepared in a suitable mortar; but when wax or resin is used, it must be melted over a slow fire, the other constituents then added, and the mass stirred until it has acquired proper consistence. Ointments, of which forty-three are enumerated in the B. P., should be kept in well-closed pots or jars, which (except when in daily use) should be covered with moistened bladder and strong paper. They are generally dispensed either in wooden chip boxes or in earthenware pots, both of which the practitioner should have of several sizes. In dispensing these and other officinal preparations, spatulæ of steel, bone, wood, and horn are essential articles of the laboratory furniture.

Oleates are solutions of active principles in oleic acid. The B. P. now includes oleatum hydrargyri and oleatum zinci.

These oleates are sometimes preferred to the corresponding ointments, on account of their being more readily absorbed. The smart friction employed in the in-rubbing of this class of remedies is itself of considerable therapeutic value. It causes temporary contraction, followed by more permanent dilatation of cutaneous capillaries, and hence promotes increased circulation through superficial blood and lymph vessels, with consequent quickened removal of waste-products. Smartly applied friction is a counter-irritant (p. 66).

Liniments or **embrocations** are solutions of active principles in oil or spirit; some, besides, contain camphor; several have soap added, to increase their lubricant properties; all are intended for external use. The B. P. enumerates sixteen liniments.

Cerates are stiff ointments containing wax.

PLASTERS—EMPLASTRA.

Plasters are **adhesive substances,** usually containing lead oxide, conjoined with resin, wax, soap, fats, tar, or pitch; are conveniently kept fused in rolls; and are prepared for use by being **spread on calico, linen, or leather.** The equable pressure of a well-applied plaster gives support and protection; retards evaporation, and hence raises topical temperature; increases glandular activity; and sometimes also hastens removal of products of inflammation. Plasters are rendered more stimulating by addition of mustard or cantharides; more soothing or anodyne by addition of opium or belladonna.

Ordinary plasters are less useful in veterinary than in human practice; for in the lower animals they are apt to be displaced from the greater power of the panniculus carnosus, and from the patient's rubbing or biting at them. Where they are to remain on for some days or weeks, the melted ingredients are applied directly to the skin, covered first with a little teased tow or lint, and then with a linen or leather bandage. Plasters of this kind are popularly known as **charges,** and were formerly much used in all kinds of lameness. Besides the benefits already enumerated, they are serviceable from their stimulating; from their preventing, when large and thick,

undue motion of injured parts; and from their insuring the patient several weeks' release from work.

POULTICES—CATAPLASMS.

Poultices are **local baths or semi-solid packs,** used for the topical application of heat and moisture. They closely resemble fomentations. They constitute an important form of emollients (p. 72). They are made of such farinaceous substances as linseed-meal, bran, or oatmeal, stirred into boiling water until the fitting consistence is reached; or of carrots or turnips, either steamed or boiled. Bread and starch make bland porous poultices, adapted for abscesses; spent hops are indicated where the poultice should be light. Unless nicely prepared, soft, fresh, and changed every two to three hours, they merit Liston's condemnation that they are associated "with putrefaction and nastiness." In order to secure to the fullest the softening of the skin, as well as the soothing of peripheral nerve-endings, poultices are generally laid directly on wounds, sores, or boils, or with only a very thin substance intervening. When used, however, either directly or reflexly, to relieve congestion, inflammation, or pain, they are placed in a well-warmed flannel bag, or in folds of flannel, which, conducting heat slowly, justifies their being applied at a higher temperature than could otherwise be borne, and, moreover, preserves heat longer. Poultices arrest superficial and circumscribed inflammation in the early stages; and in more advanced stages, when white corpuscles have escaped through the vessels, or pus has begun to form, they favour its formation, and promote maturation of the abscess. They are, however, unsuitable for wounds, which, if kept dry or treated antiseptically, will heal by first intention or adhesion, and for chronic inflammation, where the parts have become relaxed and deficient in tone. In such cases, cold applications are indicated.

Heat, without moisture, may be applied by the agency of hot bricks, salt, or sand, of hot-water bags, of well-warmed rugs or flannels, or of the smoothing-iron. A piece of flannel, thoroughly wrung out of boiling water, applied dry and hot, its

several folds covered with thin mackintosh, and kept in place by a bandage, in virtue of the heat and equable pressure, relieves strains, and diminishes fullness of the legs of horses rattled on hard roads.

In veterinary practice some ingenuity and mechanical dexterity are required to get poultices properly and securely applied. To prevent unpleasant sticking, the skin is sometimes covered with a piece of muslin, or moistened with vaselin, oil, or solution of glycerin. Before application of the poultice, the irritable inflamed surface is sometimes dressed with equal parts of belladonna extract, glycerin and water, or other anodyne. To keep the poultice as long as possible at a uniform temperature, unless its weight is injurious, it should be of considerable bulk, and usually several inches thick; hot water is poured over the mass every hour or two, or, better still, fresh poultices are supplied as the old becomes dry, lower in temperature, or foul. Such changes should be quickly effected, for exposure chills the moist warm surface. When the poulticing is done with, the surface should be enveloped in flannel, or in a woollen rug covered with oil-skin. In cases of chest and bowel inflammation, dogs, like children, are advantageously placed in jacket poultices. Poultices are rendered more soothing by addition of opiates or other anodynes; more stimulating by sprinkling with mustard or turpentine; more antiseptic by admixture with yeast, chlorinated soda, carbolic acid, or charcoal.

Too long persisted with, they are apt unduly to soften and sodden the skin, cause crops of small abscesses, and destroy reparative power. Unwieldy to apply, and troublesome to regulate as to temperature, they are often superseded by fomentations, by antiseptic dressings, by water dressings of moistened and medicated lint or tow, from which evaporation is retarded by a covering of oiled silk or guttapercha cloth, or by spongiopiline—a felted wool and sponge, coated on one surface with guttapercha, and when soaked with hot water proving a cleanly, handy substitute for a small poultice.

POWDERS—PULVERES.

Many medicines may be reduced to a rough powder in a hand-mill such as that used for grinding coffee or pepper; or in an **iron mortar** (which should be fixed into a block of wood), with a large, heavy, iron pestle, which ought to be suspended from one end of a flexible rod running along the ceiling, and fixed into the opposite wall. Preparatory to further reduction, many roots and barks are pounded or cut. To effect minuter subdivision, small quantities of the coarse powders are reduced in **hand mortars,** which are conveniently kept of wood, marble, or Wedgwood ware, the latter being cheap, easily cleaned, and little affected by acids. When a fine state of division is required, the powder is sometimes put through wire-gauze or horse-hair **sieves,** the meshes of which are made of suitable closeness. For light pungent or irritant powders, compound sieves, closed in with a lid both above and below, are used. To facilitate reduction of tough vegetable drugs such as opium, they are sometimes mixed with a hard salt, such as potassium sulphate. To avoid tedious trituration, powders, like calomel and flowers of sulphur, are conveniently obtained by sublimation; others, like magnesium carbonate or mercury red oxide, by precipitation; other insoluble substances, like prepared chalk, by stirring in water, allowing the coarser particles to settle, and pouring off the solution. from which the finely-divided powder is gradually deposited and dried. It is undesirable to purchase medicines, especially of the more expensive descriptions, in powder, in which adulterations or impurities are difficult of detection. Powders, when not too bulky, are occasionally dropped upon the patient's tongue. When without disagreeable flavour, they are sometimes scattered upon or mixed with the food, thus saving practitioners and attendants, as well as patients, much trouble and annoyance.

SYRUPS—CONFECTIONS—ELECTUARIES.

Syrups are **saccharine solutions,** usually containing flavouring or medicinal substances. Their specific gravity ranges from 1·300 and 1·400. Their consistence is important:

if too thin and weak, they become mouldy, and are apt to ferment; if too thick and strong, the sugar crystallises out. But the Brit. Phar. ensures uniformity and good keeping by definite instructions as to the proportion of refined sugar and other constituents in the seventeen syrups. Americans, fond of sweets even with their physic, have introduced thirty-three syrups into the U. S. A. Phar. Simple syrup is prepared by dissolving, by the aid of heat, five pounds of refined sugar in two pints of water. The syrups chiefly used in veterinary practice are those of buckthorn, poppies, ginger, and iron-iodide, in which the sugar prevents oxidation. **Electuaries** are made of sugar or mucilage. **Confections and conserves** are soft pastes, largely composed of sugar or honey, and, like syrups, chiefly used as vehicles for administering insoluble or disagreeable-tasted drugs.

TINCTURES—SPIRITS—ESSENCES—WINES.

Tinctures are **spirituous solutions** of active principles. Spirit is used of such strength as most readily dissolves the active principles. For solution of most alkaloids and oils, rectified spirit is preferable. Aromatic spirits of ammonia is conveniently used in the preparation of the tinctures of guaiac, valerian, and opium. Sometimes the solvent is pyroxylic spirit, and occasionally it is ether. More than half of the seventy-two tinctures of the B. P. are made with one part of the drug to eight of spirit. They are prepared without heat by simple solution, by maceration, or by displacement, or sometimes by a combination of these processes. The materials, first reduced by cutting or bruising, are placed with the spirit in a suitable vessel, and usually remain from two to seven days; the solution is poured off; the residue pressed; and the tincture, when filtered, is ready for use. Sometimes the materials, in a state of moderately fine division, are packed in a percolator or cylindrical vessel of glass, earthenware, or metal; the spirit passes gradually through them, displaces and dissolves out their soluble parts, filters through the linen or calico, which is usually stretched across the lower part of the cylinder, and passes off by the stop-cock, which should be attached to the apparatus.

Some tinctures are made by macerating the materials in water for a couple of days, obtaining the remaining active principles by percolation with spirit, and mixing the two solutions. More thorough and rapid extraction of active principles is obtained by Burton's process. The drug and solvent are packed in the percolator, on the neck of which an elastic cap is fixed; with an exhausting syringe, a partial vacuum is created; and air being subsequently admitted, the spirit penetrates the drug, and more effectually extracts its active principles.

Tinctures are clear, of a yellow, red, or brown colour, and generally keep well. The revisers of the B. P. have endeavoured to reduce dubiety and risk of accident, by enjoining the preparation of many tinctures of such uniform strength that one drachm is the average dose for an adult human patient. There are still, however, a number of more concentrated tinctures, of which the dose ranges from five to twenty minims—namely, tinctures of belladonna, cannabis Indica, digitalis, opium, and iron perchloride; while the tincture of aconite is still stronger, the dose being one to ten minims.

Medicated spirits, of which the B. P. contains eighteen, are solutions of volatile oils or ethers in alcohol, and are represented by spiritus ætheris, camphoræ, and chloroformi.

Essences are concentrated tinctures, the essence of anise and of mentha piperita, each containing one part of volatile oil to four of rectified spirit.

Medicated wines, such as vinum antimoniale and ipecacuanhæ, made with sherry or orange wine, are merely weak tinctures. **Elixirs** are tinctures mixed with aromatics and syrup.

VAPOURS—INHALATIONS.

Vapours are volatilised applications used for soothing, stimulating, deodorising, or disinfecting the air passages, or for destroying parasites lodged therein. The inhalation most frequently used is moist, warm air, produced from a steam kettle, or, in the treatment of horses, from a hot mash, placed in a capacious nose-bag, or in a large bucket brought under the nostrils, the animal's head and the bucket being covered with a piece of sacking. Such inhalations are serviceable in catarrh

and bronchial congestion, and may be rendered more soothing by mixing with the moist, warm air a little chloroform, laudanum, or conium. Antiseptic properties are conferred by impregnating the air with chlorine or sulphurous solutions, or by the use of creosote, iodine, or iodoform. As in the administration of chloroform for production of anæsthesia, volatile drugs may be conveniently inhaled from a sponge placed in one nostril. Irritability of the larynx and violent coughing are sometimes relieved by the cautious vaporising of hydrocyanic acid and conium, or by spraying the throat with cocaine. Chlorine, or sulphurous acid inhalations, twice or thrice repeated at intervals of three or four days, are usually effectual in destroying bronchial filariæ in calves and lambs.

WEIGHTS AND MEASURES, IMPERIAL AND METRIC.

Two systems of weights—the avoirdupois and the apothecaries'—were formerly employed by medical men, veterinarians, and chemists. The avoirdupois or imperial weight was used by wholesale druggists, and also by retailers in buying their drugs, and usually in selling out quantities amounting to or exceeding an ounce. In dealing with smaller quantities, and in making up prescriptions, apothecaries' weight was employed. To avoid the ambiguity occurring from the use of these two systems, the framers of the British Pharmacopœia in 1864 abolished the apothecaries' weight, adopted the avoirdupois ounce as the standard, divided it into 437·5 grains, and ignored entirely drachms and scruples. But so great is the inconvenience arising from the want of some denomination between the grain and the ounce, that medical and veterinary authorities, although dispensing with the scruple, still use the drachm (dr. ʒj.), which is one-eighth of the avoirdupois ounce, or contains 54·6875 grains.

PHARMACOPŒIA MEASURE OF WEIGHT.

1 Grain, gr.j.
1 Ounce, oz.j. ℥j. ....= 437·5 grains.
1 Pound, lb.j. ....= 16 ounces = 7000 grains.

As some veterinarians may still use the abolished apothecaries' weight, its denominations with their appropriate signs are appended, and it may be recollected that the grain is one-eleventh more than that of the B. P.

APOTHECARIES' MEASURE OF WEIGHT.

1 Grain, gr.j.			
1 Scruple, ℈j.	= 20 grains.		
1 Drachm, ʒj.	= 3 scruples	=	60 grs.
1 Ounce, ℥j.	= 8 drachms	=	480 grs.
1 Pound, lb.j.	= 12 ounces	=	5760 grs.

The measures of the B. P. are those in former use. The fluid ounce of distilled water, although weighing 437·5 grains, is still divided into 480 minims.

MEASURE OF CAPACITY.

1 Minim, min.	♏j.	
1 Fluid drachm,	fʒj.	= 60 minims.
1 Fluid ounce,	f℥j.	= 8 fluid drachms.
1 Pint,	O j.	= 20 fluid ounces.
1 Quart,	Qt.j.	= 2 pints.
1 Gallon,	C.j.	= 4 quarts.

It is often useful to recollect the weight of different measures. Of water, one minim (♏j.) weighs nine-tenths of a grain; a fluid ounce at 60° weighs exactly an ounce avoirdupois; hence a pint is equal to a pound and a quarter, and a gallon to ten pounds avoirdupois.

Practitioners require proper balances of different sizes, legibly marked weights of different denominations, and graduated measures, which, for the sake of cleanliness, should be made of glass or earthenware rather than of metal. Much time is saved both to himself and his employers by having the bottles in which his medicines are dispensed graduated to ounces; and such bottles may now be purchased at very moderate prices. To prevent mistakes, medicines for external

and internal use should be sent out in differently shaped and differently coloured bottles, properly labelled; while all potent preparations should further be labelled "Poison."

When standard measures cannot be obtained, the practitioner has often occasion to use some of the ordinary domestic utensils, with the capacity of which he ought therefore to be familiar. Common tumblers contain from eight to ten fluid ounces; tea-cups, five to seven fluid ounces; breakfast-cups, about eight fluid ounces; wine glasses, two to two-and-a-half fluid ounces; table-spoons, half a fluid ounce; dessert-spoons, two fluid drachms; and teaspoons, one fluid drachm of sixty minims. Such measurements, however, are merely approximative. The pint and quart bottles, subdivisions of the old wine measure now disused, contain respectively about 13 and 27 fluid ounces, and *not*, as their names might indicate, 20 and 40 fluid ounces. A Scotch pint contains 60 fluid ounces. Medicines are sometimes measured by the drop, which varies, however, exceedingly with the density and viscidity of the fluid, and the form and size of the vessel from which it falls.

The **metric system** of weights and measures is now legalised in this country; is everywhere extensively used in scientific observations; and, from the simplicity of its decimal gradations, is certain to become general for all purposes. The metric tables of weight, capacity, and length, with their relations to the corresponding tables of the B. P., are appended:—

MEASURES OF WEIGHT.

1 Milligramme	=	0·001	gramme	=	0·015432	grains.
1 Centigramme	=	0·01	„	=	0·15432	„
1 Decigramme	=	0·1	„	=	1·5432	„
1 Gramme	=	1·0	„	=	15·432	„
1 Decagramme	=	10·0	„	=	0·022046	lbs.
1 Hectogramme	=	100·0	„	=	0·22046	„
1 Kilogramme	=	1000·0	„	=	2·2046	„

The gramme, taken as the unit of weight, is a cubic centimetre of water at 4° C. or 39·2° Fahr.

MEASURES OF CAPACITY.

1 Millitre	=	1 gramme of water	=	0·0610 cubic in.
1 Centilitre	=	10 „ „	=	0·610 „
1 Decilitre	=	100 „ „	=	6·10 „
1 Litre	=	1000 „ „	=	61·0 „

A litre is a cubic decimetre, equal to one kilogramme, or 1·76 pint.

MEASURES OF LENGTH.

1 Millimetre	=	0·001 metre	=	0·03937 English in.
1 Centimetre	=	0·01 „	=	0·3937 „
1 Decimetre	=	0·1 „	=	3·937 „
1 Metre	=	1·0 „	=	39·37 „
1 Decametre	=	10·0 „	=	32·80 English ft.
1 Hectometre	=	100·0 „	=	328·08 „

A metre is equal to the ten-millionth part of a quarter of the meridian of the earth. It is equal to 3·28 English feet.

The Fahrenheit **thermometer,** being the measure of temperature still retained by the B. P., and in many works on human Materia Medica, is the measure again adopted in this book. The Centigrade scale, however, is now extensively used. It is often requisite to ascertain the corresponding numbers on each scale, and for this purpose the following rule is useful. To convert any number of Centigrade into Fahrenheit degrees, multiply by 9, divide by 5, and add 32. For the converse process, subtract 32, multiply by 5, and divide by 9.

VETERINARY MEDICINES.

ACIDS—ACIDA.

The mineral acids, with acetic, tartaric, and oxalic acids, resemble each other in their actions and uses, and may be conveniently grouped together. Boric, sulphurous, carbolic, salicylic, tannic, and hydrocyanic acids differ chemically and physiologically, and will be separately dealt with in their alphabetical order.

Sulphuric Acid	Acetic Acid
Hydrochloric "	Tartaric "
Nitric Acid "	Lactic "
Nitro-hydrochloric "	Oxalic "
Phosphoric "	
Chromic "	
Hydrobromic "	
Carbonic "	

Acids are hydrogen salts which in presence of an alkali exchange for it their hydrogen or a portion of it. Thus nitric acid (HNO_3), in presence of potash (KHO), forms potassium nitrate ($KNO_3\,H_2\,O$); hydrochloric acid ($HCl.$), in presence of soda ($Na\,HO$), forms sodium chloride ($Na\,Cl.\,H_2O$). Most acids, moreover, are popularly described as soluble substances with a sour taste, and a power of reddening many blue and violet colouring matters.

In virtue of their **affinity for basic substances and for water,** acids, especially when concentrated, form new compounds with the animal tissues. Their primary effects are (1) to unite with and neutralise the free alkali which is present in most normal tissues; (2) the stronger often displace weaker acids; (3) they precipitate albumin, while all the mineral acids, except nitric, again dissolve albumin. When introduced

into the blood they, moreover, decompose hæmoglobin, forming a substance which parts with oxygen much less readily. They coagulate myosin, and hence cause muscular rigidity. The stronger acids, especially when concentrated, in fulfilling these affinities, are caustics and escharotics (p. 66). Weaker and more diluted acids act as rubefacients, cause temporary congestion and contraction of blood vessels, and, if freely or continously applied, inflame the dermis, producing vesication (p. 65).

Acids, when swallowed are **corrosive, irritant poisons.** As with other irritants, they are more active and fatal in horses and dogs than in cattle or sheep, in which their toxic effects are diminished by admixture with the bulky food usually present in the first stomachs of these ruminants. "In cases of acute poisoning, where death has not occurred too quickly, much albumin, hæmatin, and indican have appeared in the urine, and fatty degeneration in the liver, muscles, and kidney has been found" *Dr Lauder Brunton.* Their appropriate **antidotes** are alkaline bicarbonates, calcium and magnesium carbonates, given with such diluents and demulcents as milk, oil, and linseed gruel, and followed by opium and fluid nutrients (p. 120).

Acids in the mouth **increase the saliva** from the parotid and sub-maxillary glands, have no effect on the sympathetic saliva, and effectually moisten the fauces and allay thirst (p. 74). As they are in part neutralised by the alkaline saliva, the resulting salts exert some astringent and antiseptic effects. If not neutralised before they reach the intestines, they increase their alkaline secretions, and also that of the alkaline bile. Dr Sidney Ringer (Handbook of Therapeutics) believes that **acids increase alkaline secretions,** while, conversely, alkalies increase acid secretions. He, moreover, states that acids hinder acid secretions. Whether they do so merely by neutralising the alkalies which stimulate acid secretion, or by some further action, is not ascertained.

Acids **assist digestion** apparently in several ways.

(1.) **They furnish** the gastric juice with its **acid constituent,** which, unlike the pepsin, is not capable of reproduction, and without which the digestive power of the gastric solvent is

impaired. Hydrochloric acid, being the chief natural gastric acid, is generally prescribed when the acidity of the gastric fluid is believed to be deficient, as it sometimes is in young animals living chiefly on milk, in febrile enfeebled or old subjects, or in those suffering from gastric catarrh. To effect these purposes, acids are given along with or shortly after food. Where there is want of appetite and irregular action of the bowels, acids are given conjoined with bitters.

(2.) Acids **check gastric secretion** where it is excessive, as it appears to be in cases of indigestion, where the fluids in the mouth are sour, not only after, but before, feeding, and where animals instinctively lick the walls, or eat alkaline earthy matters. In such cases the alkaline treatment frequently adopted affords temporary relief; but a laxative, followed by acids, generally removes the conditions on which the dyspepsia depends. To such patients acids are given before feeding.

(3.) Acids acting **antiseptically** check fermentation, and thus prevent formation of gases and irritating organic acids. In this way they are serviceable not only in indigestion, but in certain cases of diarrhœa.

Before reaching the circulation, acids must **pass through the liver,** where they appear to set free biliary acids (*Ringer*), stimulate expulsion of bile from the liver and gall-bladder, alter processes of tissue change, and check formation of urea (*Brunton*). As hepatic tonics and stimulants, nitric and nitro-hydrochloric acids are preferred (p. 91).

When **they enter the general blood current,** their acidity must be considerably neutralised. They, nevertheless, still act specially as acids, for their alterative and tonic effects are not the same as those of the salts they form when fully neutralised. They are **excreted** from the body in part through the intestinal glandular apparatus, but chiefly by the kidneys, in combination with ammonia and other bases. Full or repeated doses diminish, however, the alkalinity, or increase the normal acidity, of the urine. The vegetable acids, being readily oxidised into carbonates, exert a primary acid, but a secondary alkaline, effect, notably on the urine.

On account of their diminishing secretion of gastric juice, acids should not be prescribed for more than a week or ten

days at a time. They must be given freely diluted, and are often conjoined with bitters, iron salts, and alcoholic stimulants.

The several acids, although possessing various properties in common, have some **distinguishing characteristics.** Hydrochloric, being very volatile, and possessing, besides, a strong affinity for water, whether in the gaseous or fluid state, is most destructive to vegetation, browning and shrivelling the plant tissues. Hydrochloric, sulphuric, and phosphoric acids are the most powerfully corrosive. Nitric acid does not so readily redissolve the precipitated albumin, and hence is scarcely so penetrating as other mineral acids. Sulphuric acid, when applied to the skin or swallowed, causes blackening or browning of the parts with which it comes into contact; nitric acid leaves a yellow stain; hydrochloric, a white film of precipitated albumin. The special uses of the three important mineral acids are thus indicated by Dr Bence Jones:—"Hydrochloric," he says, "promotes digestion; nitric, secretion; sulphuric, astringency." Nitric and nitro-hydrochloric acids are chiefly useful as hepatic tonics and stimulants. Tartaric and citric acids, and vinegar, are much less powerful than the mineral acids.

Sulphurous, boric, benzoic, and salicylic acids, used for their antiseptic rather than for their special acid properties, with their salts, will be dealt with later. Carbolic acid is also an antiseptic, and an alcohol rather than an acid. Arsenious acid is not a true acid, but an anhydride. Tannic and gallic acids, although they have acid reactions, are glucosides. The striking actions of hydrocyanic acid distinguish it from all other acids. These acids will accordingly receive separate notice under their English names.

SULPHURIC ACID.

Acidum Sulphuricum. Hydrogen Sulphate. Oil of Vitriol. An acid produced by the combustion of sulphur and the oxidation and hydration of the resulting sulphurous acid by means of nitrous and aqueous vapours. It contains about 98 per cent. of real acid. H_2SO_4 or $SO_2(OH)_2$ (*B. P.*)

Manufacture.—Into large leaden chambers, the floors of which are covered with water, gaseous sulphurous anhydride

(SO_2) is introduced from the burning of sulphur or the roasting of iron pyrites. Nitric acid ($H\ NO_3$), obtained by the action of sulphuric acid on potassium or sodium nitrate, is discharged with jets of steam into the chambers, and supplies the oxygen which converts the sulphurous into sulphuric acid ($H_2\ SO_4$). The nitric acid is thus changed into nitrous anhydride ($N_2\ O_3$), which, in the presence of air, regains oxygen, and, without itself undergoing much diminution, continues the carrier of oxygen from the air to the sulphurous acid. The diluted sulphuric acid formed in the chambers is concentrated in leaden vessels to the specific gravity 1·72, when it constitutes the brown acid of commerce. For pharmaceutical or chemical purposes, it is further concentrated in platinum or glass vessels.

PROPERTIES.—The strong acid of commerce contains about 98 per cent. of real acid ($H_2\ SO_4$), has the specific gravity 1·843, is oily looking, colourless, odourless, with an intensely acid, acrid taste. It freezes about—30° Fahr., boils at 640° Fahr., absorbs moisture from the air, and hence, if kept in unstoppered bottles, speedily becomes diluted. It has great affinity for water, mixes with it in all proportions, with evolution of much heat. Thus combining with water and albumin it decomposes and chars organic substances and soft animal tissues. When heated with charcoal, sulphur, or metals it readily parts with oxygen, and is converted into sulphurous acid.

The acidum sulphuricum dilutum, or medicinal acid, contains 13·65 per cent. of real acid. **The acidum sulphuricum aromaticum,** containing eighteen fluid parts of rectified spirit, and flavoured with cinnamon and ginger, has 12·5 per cent. of real acid.

The test for sulphuric acid is its forming, in diluted solution, with soluble barium salts, an abundant white precipitate ($Ba\ SO_4$), insoluble in nitric or hydrochloric acids. Sulphuric acid is a **dibasic acid** (H_2SO_4), and forms a triple series of salts: its two hydrogen atoms may be displaced (1) by two atoms of the same metal constituting a normal sulphate, as potassium sulphate ($K_2\ SO_3$); (2) by one of two different metals where a double sulphate like potassium aluminum sulphate is

formed (K Al) $(SO_4)_2$ 12 HO_2; or (3) one atom of hydrogen remains and one is replaced by a metal constituting an acid sulphate like potassium acid sulphate (K H SO_4).

Impurities.—The specific gravity and neutralising power of the volumetric solution of soda indicate the proportion of water. 50 grains by weight of the strong acid, mixed with an ounce of distilled water, require for neutralisation 1000 grain measures of the volumetric solution of soda. (*B. P.*) Even traces of organic matter cause discoloration. Lead or arsenic is discovered by diluting the acid, and adding hydrogen sulphide. If nitrous compounds are present, iron ferrous snlphate solution cautiously added produces a purple colour where the two liquids meet.

Actions and Uses.—Sulphuric acid is a corrosive irritant poison; is used medicinally as a refrigerant, antiseptic, tonic, and astringent; and externally as a caustic, stimulant, and astringent.

Toxic Effects.—In concentrated form, it almost immediately produces retching, with emesis in animals that vomit. The vomited matters are acid, stain and corrode, are often dark, viscid, and bloody, and contain shreds of mucous membrane. From irritation and swelling of the throat breathing is frequently difficult, and when a strong acid has been swallowed in human patients, or in rabbits experimented upon, death from suffocation has resulted in an hour, or even less time (*Taylor on "Poisons"*). There is great abdominal pain, rapidly increasing prostration, and death usually in 12 to 24 hours. The mouth, fauces, gullet and stomach exhibit brown and black stains, and patches of corrosion, and there is sometimes perforation of the stomach. When the acid has been diluted, and death does not occur for several hours, the digestive mucous membrane is found softened, swollen, and inflamed, but not so blackened or charred as when the acid has been concentrated, and death more rapid. Injection into the veins proves fatal by coagulation of blood and thrombosis (Orfila).

In various parts of England, sulphuric and other acids are sometimes ignorantly given by carters, with the idea of improving the condition of their teams. Acute poisoning occasionally occurs from overdoses, chronic irritation of the

bowels not infrequently results; and horses which for a season have thus been senselessly doctored, usually continue for months and even for years thriftless, and difficult to keep in condition.

The appropriate **antidotes** are alkaline bicarbonates, chalk, or magnesium carbonate, given diluted in milk or water, in small quantity at short intervals. Demulcents are subsequently administered. Where the breathing is difficult, tracheotomy is performed.

Medicinal Uses.—Sulphuric acid is prescribed as a **tonic** and **astringent.** It is given in chronic diarrhœa and dysentery usually with laudanum in starch gruel or mucilage. In influenza in horses, with a tendency to œdema or purpura, I have seen benefit from thirty drops of the medicinal acid given in gruel or ale several times a day, with an ounce each of ether and powdered cinchona bark. In purpura the late Professor Robertson prescribed f℥½ sulphuric acid, and grains xxx. iron sulphate, in cold water three times daily. In relaxed and ulcerated sore throat amongst horses, a diluted solution, slowly given, exerts the twofold influence of a local astringent and general tonic. It was wont to be prescribed in contagious pleuro-pneumonia amongst cattle, but was not more successful than iron sulphate or other tonics. It sometimes checks bleeding from the lungs and stomach, arrests excessive perspiration, and, correcting gastric derangement, abates the itching of chronic nettle-rash and lichen. It is an antidote for chronic poisoning by lead, and for alkalies.

Externally it is used for **cauterising** irregular, sinuous, and poisoned wounds, and as a **styptic** and **astringent.** Three parts strong acid, thoroughly mixed with one of asbestos, and rubbed to fine powder, are used in France for removing cancerous and other swellings; a half-an-inch layer placed over a tumour the size of an egg is stated to remove it in twelve hours. For destruction of cancer the late Professor Syme made sulphuric acid into a thin pulp with sawdust, protecting the neighbouring tissues by a wall of gutta percha. It is used in like manner to destroy warts, which, from their shape or situation, cannot readily be removed by knife or ligature. It hastens

disintegration of necrosed bone. It is occasionally added to blistering ointments, but, unless in small amount, is apt to cause blemishing. A few drops given along with Epsom salt and other saline purgatives, diminish their disagreeable taste and rather increase their activity.

Doses, etc.—Of the medicinal acids horses take fʒj. to fʒij.; cattle, fʒij. to fʒiv.; sheep, fʒ$\frac{1}{2}$ to fʒj.; pigs, ♏x. to ♏xx.; dogs, ♏ij. to ♏vi.; repeated several times a day; given freely diluted, and often conjoined with aromatics and bitters. As an external astringent, ten to twenty drops of medicinal acid are mixed with an ounce of water.

HYDROCHLORIC ACID.

Acidum Hydrochloricum. Muriatic Acid. Spirit of Salt. Hydrochloric Acid Gas (H Cl) dissolved in water, and forming about 32 per cent. by weight of the solution (*B.P.*)

When one volume each of hydrogen and chlorine are mixed, and exposed to sunlight or an electric spark, combination occurs with explosive violence, and there result two volumes of the colourless, pungent, acrid, irritating, hydrochloric acid gas. The acid of commerce and medicine is mostly got as a by-product in the manufacture of sodium carbonate from common salt. The Pharmacopœias order the distilling together of sodium chloride, sulphuric acid, and water; acid sodium sulphate remains in the retort; hydrochloric acid gas distils over; is purified by passing it through a wash bottle containing a limited amount of water, and thence is conducted into a retort about two-thirds filled with distilled water, which dissolves 32 per cent. of the gaseous acid. This preparation is colourless, intensely sour and acrid, emits white pungent fumes of the gas, and has the spec. grav. 1·16. A still stronger acid may be made, containing 43 per cent. by weight or 480 volumes of gaseous acid, and reaching the spec. grav. 1·21. The B.P. **acidum hydrochloricum dilutum** is made by mixing eight fluid ounces of the stronger acid with water until the mixture at 60° measures 26$\frac{1}{2}$ fluid ounces. It has the spec. grav. 1·052, and contains 10·58 per cent. of gaseous acid. **The test** for hydrochloric acid is its producing, with silver

nitrate, a curdy white precipitate (Ag Cl), insoluble in nitric acid, but soluble in excess of ammonia. Its chief **impurities** are sulphuric and sulphurous acids, nitrous compounds, chlorine, iron, and occasional traces of arsenic.

Actions and Uses.—Concentrated doses are corrosive and irritant; medicinal doses are astringent, antiseptic, tonic, and antidotes for poisoning by alkalies; it is excreted mainly in the urine, increasing its quantity and diminishing its alkalinity. Topically it is used as a caustic, stimulant, astringent, and antiseptic.

Toxic Effects.—Like the other mineral acids concentrated solutions have a strong affinity for the water bases and albuminoids of the tissues. They leave upon them a white film. When swallowed they cause gastro-enteritis. Independently of irritant or corrosive effects, they appear to destroy life by neutralising the alkali of the blood. Rabbits and other herbivora are stated to suffer in this way more readily than dogs or other carnivora. Seven or eight grammes per kilogramme of body-weight may be given to rabbits in twenty-four hours without serious results, but nine grammes prove fatal in a few hours, causing frequent laboured breathing, quick pulse, imperfect power of moving, and death, depending upon fatal diminution of alkali in the blood, determining first stimulation, and soon paresis of the respiratory centre. That these toxic effects directly depend upon neutralising of the alkali in the blood, appears to be demonstrated by Mr F. Walter's experiments, in which animals nearly dying from acid poisoning promptly revived when sodium bicarbonate was injected into the veins. The alkaline antidote proves effectual even when three times the ascertained fatal dose of acid has been administered (Phillip's *Mat. Med.*, 1882).

Medicinal Uses.—Hydrochloric acid, made into an electuary with glycerin, treacle, or honey, or diluted with water, while slowly swallowed, exerts stimulant antiseptic, or astringent effects on **irritable, relaxed, or ulcerated throats.** Stimulating the mucous membrane of the mouth, it reflexly evokes **secretion of saliva,** moistening the parched mouth and abating thirst. Like other acids, it specially stimulates the mucous,

intestinal, and other alkaline secretions. These effects are increased by combining the acid with gentian or other bitters. Hydrochloric acid is the **special acid** of the **gastric juice**; in herbivora it amounts to ·15, in dogs to ·3 per cent. When the natural acid constituent of the fluid is deficient, digestion is performed tardily and imperfectly, and fermentation of the food, and evolution of gas and acrid acids occur. For obviating or removing such conditions, hydrochloric acid is specially chosen, it **aids digestion** especially of albuminoid food, controls acid fermentation common in young animals, particularly when feeding on milk, and hence often checks diarrhœa. In young calves or foals, digesting their food indifferently and scouring, three or four drops of medicinal acid used with the milk, or given immediately before feeding, with or without pepsin, usually answer better than lime-water or alkalies. Acids and bitters are also useful for convalescents from exhausting disease, for show beasts that have been systematically over-gorged, and for young and weakly, as well as for old enfeebled subjects. The acid treatment is equally appropriate in the totally different gastric condition of undue acidity depending upon excessive secretion; but to check such inordinate secretion the acid should be administered half-an-hour before feeding. Given alone or with iron chloride, it promotes a healthier state of the bowels in animals affected by intestinal worms, and sometimes expels ascarides. Like other mineral acids it exerts some unexplained alterative action as it passes through the liver, and during excretion acidifies the urine.

Externally, hydrochloric acid is used for the destruction of warts, and as a **caustic** and **antiseptic** for wounds, for foot-rot in sheep, and occasionally as a styptic. A tepid solution, diluted until only faintly acid to the tongue, is sometimes used, instead of vinegar and water, for rapidly sponging the skin of febrile patients.

DOSES, ETC.—Of diluted or medicinal acid, horses take f℥½ to f℥ij.; cattle, f℥ij, to f℥iv.; sheep and pigs, ♏xv. to ♏xx.; dogs, ♏iij. to ♏x., usually prescribed with forty or fifty times its bulk of water; often given along with bitters and iron salts.

NITRIC ACID.

Acidum Nitricum. Aquafortis, $H NO_3$.

The strong acid of commerce and medicine **is prepared** in iron retorts from seven parts of potassium or sodium nitrate, four of sulphuric acid, and water. It **contains** 70 per cent. of real nitric acid ($H NO_3$), has the spec. grav. 1·42, but is inconveniently unstable and caustic, and gives off nitrous fumes. The B. P. recognises a **diluted acid** with the spec. grav. 1·101, and containing 17·44 per cent. of anhydrous acid.

PROPERTIES.—Nitric acid, in tolerably concentrated solution, is colourless; emits pungent, corrosive, suffocating fumes; has an intensely sour taste; oxidises, corrodes, and dissolves many organic substances; has great affinity for water; in imperfectly stoppered bottles, it soon increases in quantity and diminishes in strength; diluted with water it evolves much heat.

Its characteristic **tests** are—(*a*) The production of an orange-red colour with a solution or crystal of morphine or brucine; (*b*) copper, mercury, and some other metals deoxidise strong solutions, with evolution of ruddy nitrous acid fumes ($N_2 O_3$); (*c*) it gives a yellow stain of picric acid to wool and to the skin—a decoloration deepened by alkalies, and removed from the skin only by its desquamation; (*d*) it bleaches a warm solution of indigo sulphate; and (*e*) with a solution of ferrous sulphate produces an olive-brown coloured ring where the two liquids meet. With bases, nitric acid forms an extensive series of soluble salts, the **nitrates,** which deflagrate when heated, and give the olive-brown or dark purple colour when a few crystals of ferrous sulphate are dropped into a cold solution in a test-tube, gently shaken, and eight or ten drops of strong sulphuric acid are added. Heated with strong potash solution, zinc dust, and iron filings, the nitrates give off ammonia.

IMPURITIES.—The tests of purity are the specific gravity, which indicates the proportion of water; freedom from colour, proving absence of ruddy-coloured nitrous acid; any trace of sulphuric acid is precipitated from a diluted solution by barium chloride; while hydrochloric acid is precipitated by silver nitrate.

Actions and Uses.—Nitric acid is **irritant** and **corrosive,** and especially destructive when in concentrated solution, and containing the volatile nitrous acid. It leaves yellow or brown stains on the skin and throat, but in the stomach this discoloration is usually obscured by inflammation or extravasation of blood. It is specially used as a **hepatic stimulant and tonic** frequently indicated in horses convalescing from influenza, jaundice, and other debilitating disorders, and, alternated with arsenic, in eczema and chronic skin diseases.

Externally it is applied for extirpating warts, fungous and malignant growths which cannot be removed by the knife; for dissolving the hardened scurf and promoting a healthier condition of skin in mallenders and chronic eczema; and as a caustic in poisoned wounds, caries, foul, and foot-rot. As an escharotic it is generally applied on a splinter of soft wood; surrounding tissues are protected by moistening with oil, and undue action arrested by subsequent washing with an alkaline solution. Freely diluted in hot water it abates the itching of nettle-rash. Dissolved in eighty or a hundred parts of water, the diluted acid is used for sponging the skin, and for relieving the tenderness and tension of piles in dogs. Nitric acid preserves putrescible substances, and prevents evolution of hydrogen sulphide and other noisome gases more effectually than either hydrochloric or sulphuric acids; but it is ineligible as a disinfectant, owing to its oxidising organic and metallic substances, and producing irritant effects if its fumes are incautiously breathed.

Doses, etc.—Of the diluted medicinal acid, horses or cattle take f ʒ i. to f ʒ ij., sheep and pigs ♏ x. to ♏ xx., dogs ♏ ij. to ♏ x. It must be largely diluted with water or other bland fluids, and is often conjoined with bitters. For external application, a drachm of strong acid to the pint of water suffices for all except escharotic purposes. An **ointment** is occasionally used, made by melting together in a glass vessel a pound of olive oil, four ounces of axunge, and when the mixture is nearly concrete, adding six drachms of nitric acid, and stirring briskly with a glass rod till the whole solidifies. A **paste** made with sulphur and lard is also in use for extirpating warts, destroying acari, and stimulating the scurfy skin.

NITRO-HYDROCHLORIC ACID.

Acidum Nitro-Hydrochloricum. Nitro-Muriatic Acid. Aqua regia.

When one measure of nitric acid and three of hydrochloric are mixed, red acid fumes are evolved, and there results a golden-yellow corrosive liquid, a compound of nitric oxide and chlorine, to which its owes its suffocating odour, and its property of dissolving gold and platinum. The **diluted medicinal nitro-hydrochloric acid** of the B. P. is prepared by adding to twenty-five fluid ounces of distilled water in a glass-stoppered bottle, three fluid ounces of nitric acid and four of hydrochloric, and allowing the mixture to stand for fourteen days before it is used. It contains free chlorine, and has the spec. grav. 1·07.

Actions, Uses, and Doses.—The strong acid is very corrosive and irritant. Medicinal doses are believed to exert special tonic and stimulant actions on the skin, liver, and intestinal glands, and are used in hepatic torpidity, rickets, and occasionally in equine influenza. It is prescribed in the same doses as nitric acid, and with the same precautions as to dilution and avoidance of too frequent or prolonged use. It is sometimes applied as an escharotic.

PHOSPHORIC ACID, H_3PO_4.

Acidum phosphoricum concentratum is prepared by heating phosphorus with diluted nitric acid until nitrous fumes cease to form, and diluting it with water until it has the spec. grav. 1·5, when it contains H_3PO_4, with 33 per cent. of water. It is a colourless, sour, syrupy liquid, with an acid reaction. In diluted solution it gives, with ammonio silver nitrate, a canary-coloured precipitate, soluble in ammonia and dilute nitric acid. **The acidium phosphoricum dilutum** is prepared by mixing three parts concentrated phosphoric acid with twenty of water. It contains 13·8 per cent. of H_3PO_4. It is a colourless liquid of spec. grav. 1·08.

Compared with the other mineral acids, it is not so corrosive,

but **is used** for many of the same purposes, is believed to be less apt to derange digestion when given for any considerable period, and has some reputation in checking tuberculosis and the growth of bony tumours.

CHROMIC ACID, $Cr\,O_3$.

Acidum chromicum is prepared from potassium bichromate, occurs in crimson, deliquescent, needle-shaped crystals, and is very soluble in water. The liquor acidi chromici is made with one part of acid and three of water. It readily parts with oxygen, oxidises organic matters, destroys low organisms, decomposes ammonia and sulphuretted hydrogen, and is hence a caustic, antiseptic, deodoriser, and disinfectant.

HYDROBROMIC ACID, H Br.

Diluted hydrobromic acid, containing 10 per cent. of gaseous hydrobromic acid (H Br) and 90 of water, is employed in human medicine as a nerve sedative for most of the purposes for which potassium bromide is prescribed, and has been recommended as an anodyne for nervous diseases of dogs in ♏ xx to ♏ l doses (*Veterinarian*, June 1888).

CARBONIC ACID.

Acidum Carbonicum. Carbon Dioxide. Carbon Anhydride. Choke Damp. After Damp. CO_2.

When air is inhaled, by either man or the domestic animals, containing more than $\frac{1}{200}$ parts by volume of carbonic acid, discomfort and languor are produced. An atmosphere containing $\frac{1}{12}$ promptly prevents removal of the carbonic acid from the blood, **interferes with oxidation** of the tissues, and hence impairs or arrests their functions. As with most drugs which produce death by asphyxia, three stages are usually well marked; (1) dyspnœa, (2) convulsions, (3) paralysis. Examination after death discovers general venous congestion, the blood dark coloured, the right side of the heart much distended with blood, the brain congested, and sometimes exhibiting exudation and

extravasation. In such cases of poisoning, endeavour is made to oxygenate the stagnating venous blood by bringing the animal into a pure atmosphere, stimulating respiratory effort by dashing cold water over the head and neck, employing artificial respiration, and, if the action of the heart is failing, relieving its engorgement by drawing blood from the jugular vein. Carbonic acid in solution applied to the skin or stomach produces stimulation. Effervescent drinks increase gastric and intestinal secretion, and are excreted from the kidneys more rapidly than corresponding quantities of non-ærated water.

ACETIC ACID.

The British Pharmacopœia recognises the following varieties of acetic acid:

Glacial acetic acid, contains	98·8	per cent.	anhydrous acid:	1·058 spec. grav.
Acetic acid, . . .	33	,,	,,	1·044 ,,
Diluted acetic acid, .	4·27	,,	,,	1·006 ,,
Vinegars, . . .	5·41	,,	,,	1·017·19 ,,

Glacial acetic acid is prepared by heating sodium acetate with sulphuric acid. When rectified it contains one per cent. of water, and corresponds to 84 per cent. of acetic anhydride—a colourless volatile pungent liquid ($HC_2 H_3 O_2$) or ($CH_3 CO_2H$). The glacial acid is mobile, oily, and colourless, with a pungent acetous odour and taste, and a corrosive action upon organised tissues. It boils at 243° Fahr., distils unchanged, is combustible, miscible in all proportions with water and alcohol, crystallises at 34° Fahr. into radiating pearly plates, hence its title of glacial acetic acid.

Acetic Acid (acidum aceticum, B. P.) is about one-third the strength of the glacial acid, is colourless, strongly acid, with a pungent odour. It is usually prepared from the **destructive distillation of wood** or sawdust. The condensed products separate into two layers—the lower consisting of wood tar; the upper, an aqueous solution of 2 to 4 per cent. of pyroligneous or acetic acid, associated with methyl alcohol, acetone, and other allied bodies. Sodium carbonate is added; the volatile hydrocarbons are distilled off; the remaining liquid is evaporated; sodium acetate crystallises, and when distilled with sulphuric acid, acetic acid is produced. An

imperfectly purified acid, still containing some residual tarry matters, is sold as **pyroligneous acid.** A mixture of one volume of this commercial acid with seven of water constitutes the B. P. **diluted pyroligneous acid** which corresponds in strength with vinegar.

Acetic acid, even when considerably diluted, reddens litmus, dissolves volatile oils, resins, camphor, and most alkaloids, and unites with bases to form the crystallisable and soluble **acetates,** which are distinguished by the acetous odour they emit when heated with sulphuric acid; the pleasant odour of acetic ether they evolve when heated with alcohol and sulphuric acid; and the red-brown colour they produce in neutral solution when treated with iron perchloride—a colour which changes on boiling to a brown precipitate of basic acetate of iron.

Vinegar (acetum) is diluted acetic acid sometimes containing traces of colouriug matter, mucilage, alcohol, ethers, sulphuric acid, and calcium sulphate. Besides being got from the destructive distillation of wood, as described above, it is also obtained from the oxidation of impure alcohols, by exposing them to the air, at a temperature of about 80°, and in contact with a ferment. In this way vinegars are manufactured in this country, from malt, grain, cider, or solutions of sugar or spirit; in France, by exposing the poorer wines in half-filled casks; and in Germany, by what is termed the quick vinegar process, from weak spirits mixed with about one 1000th part of yeast, or beet-root juice, and allowed slowly to trickle at a temperature of from 75° to 80° Fahr. over a large surface of wood-shavings previously soaked in vinegar. There is shortly formed on the surface of the shavings a gelatinous mould—the mycoderma aceti—which favours attraction of oxygen from the air, supplies it to the alcohol, and hastens its conversion into acetic acid, as shown by the formula—

C_2H_6O (ethyl alcohol) $\times$ O_2 (oxygen)$=C_2H_4O_2$ (acetic acid) $\times$ H_2O or $CH_3.CH_2.OH$ (alcohol) $\times$ $O_2=CH_3.CO_2.H$ (acetic acid) $\times$ H_2O.

Actions and Uses.—Acetic acid is corrosive, irritant, and vesicant. It is not used internally. Diluted, usually in the form of vinegar, it is employed externally as a stimulant and refrigerant, and pharmaceutically as a solvent.

Toxic Effects.—An ounce of acetic acid destroyed a

medium-sized dog in an hour, with symptoms of uneasiness, abdominal pain, vomiting and collapse; a quarter of an ounce was fatal in five to nine hours; four or five ounces of vinegar in ten to fifteen hours *(Christison on "Poisons")*. Horses take six to twelve ounces of vinegar, and cattle three or four pounds, without apparent injury *(Hertwig)*. Once in high repute as an antidote for many sorts of poisoning, vinegar is now employed only in the case of the alkalies and alkaline carbonates.

EXTERNAL USES.—Rubbed into the skin, acetic acid speedily causes redness, and eruption of large blisters resembling those produced by boiling water; but as a vesicant, mustard or cantharides is preferable. As an astringent or caustic it is rarely used Dissolving albumin, fibrin, and gelatin, it removes warts, as well as corns in the human subject, softens scurf, destroys cryptogamic parasites and acari, and hence is sometimes found in prescriptions used in cases of mallenders and sallenders, ring-worm, scab, and mange. Along with either hot or cold water, vinegar is used for contusions and strains, and for sponging the skin and checking excessive perspiration in febrile disorders. For fumigating stables or cowhouses, it does more harm than good, inasmuch as it disguises those noxious effluvia which it neither removes nor destroys, and may thus prevent due attention to thorough ventilation, and the use of effectual disinfectants. It dissolves the active principles of many medicines, and enters into the composition of aceta or vinegars of cantharides and opium. **Oxymel** is made by heating together forty ounces of sugar or honey, and five each of acetic acid and distilled water. The antiseptic properties of vinegar recommend it for preserving various vegetables.

TARTARIC ACID, $H_2 C_4 H_4 O_6$.

Acidum tartaricum is prepared from potassium acid tartrate, or argol, the incrustation found in the interior of wine casks ($2\ C_4 H_4 O_6 KH$), by boiling it with water, gradually adding chalk, and then calcium chloride, washing the calcium tartrate, decomposing it with sulphuric acid, decanting the

acid solution from the calcium sulphate, and evaporating and crystallising. The crystals are colourless oblique rhombic prisms, with an acid taste, soluble in less than their own weight of water, and less than three times their weight of rectified spirit. Either watery or spirituous solution not too much diluted when stirred with potassium acetate, yields a white crystalline precipitate.

Tartaric acid is devoid of irritant and poisonous properties. Christison gave drachm doses to cats without causing them apparent inconvenience. It is used as a cooling antipyretic.

LACTIC ACID, $HC_3 H_5 O_3$.

Acidum lacticum is prepared by the fermentation of glucose with putrid cheese in presence of chalk, and when purified is a syrupy liquid, which the B. P. states contains 75 per cent. of absolute lactic acid, and 25 per cent. of water.

It is used as a caustic, and, diluted and sweetened, is occasionally substituted for hydrochloric acid in dyspepsia. It is present in the gastric juice; while sacrolactic acid, which is isomeric with it, is found in the juice of flesh and in the bile.

OXALIC ACID $(CO_2 H)_2$.

Acidum Oxalicum occurs in rhubarb, sorrel, and other plants, is prepared on the small scale by oxidising sugar with nitric acid, and for commercial purposes, by the oxidation of sawdust with potash. It forms monoclinic prisms resembling those of Epsom salts, for which it is sometimes mistaken; is soluble in nine parts of water, and in alcohol, and is entirely dissipated by heat.

It is an irritant poison, but not so corrosive as the mineral acids; two drachms killed rabbits in 15 minutes; half a drachm in 30 minutes. It is introduced into the B. P. as a chemical test.

ACONITE.

Monkshood. Wolfsbane. Blue Rocket. Aconitum. The root, fresh leaves, and flowering tops of Aconitum Napellus. *Nat. Ord.*—Ranunculaceæ.

Botanists have numbered twenty-two species and upwards of a hundred varieties of aconite, which are common throughout the cooler mountainous countries of both hemispheres. Some species are eaten as vegetables, some are bitter tonics; but others, as the Aconitum ferox, Sinense, and Napellus, are sedative poisons. The last of these, the common officinal species, is a doubtful native of Britain, but often grown in gardens and shrubberies on account of its flowers. Its several varieties are herbaceous, with perennial tapering, carrot-shaped, brown roots, with lateral rootlets, from which, after the first year's growth, are formed one or more oval tubers, at first nourished by the decaying parent root; several annual erect glabrous stems two to five feet high; numerous alternate dark green leaves with long channelled stalks very deeply cut palmately into five or three segments, which are again deeply and irregularly divided into oblong acute narrow lobes; long-stalked, helmet-shaped blue or purple flowers, which form loose terminal racemes, and appear in June or July; and dry, black, angular seeds, which ripen about the end of August.

The B. P. directs that **the fresh leaves** and **flowering tops,** which are used for the preparation of the extract, shall be gathered when one third of the flowers are expanded. **The dried roots,** from which are prepared the tincture liniment and active alkaloid, are imported from Germany or cultivated in Britain. They are two to three inches long, and from half an inch to nearly an inch thick at the crown, which is knotty; are brown externally, but pinky white within; conical, rapidly tapering, prominently marked with the bases of the rootlets, of an earthy odour,—characters which should distinguish them from the larger, longer, more uniformly cylindrical, white, pungent, bitter root of horse-radish, for which aconite roots have sometimes been fatally mistaken. According to Professor Schroff, of Vienna, the root is six times as active as the other

parts, and should be taken up after the plant has flowered in autumn, or before the new stem rises in spring, cut into small pieces, and dried at a low temperature. The leaves are less active than the root, but more so than the flowers, fruit, or stem. Any part of an active aconite, when slowly chewed, produces a peculiar acridity, tingling, and numbness of the lips and tongue, unaccompanied by irritation or inflammation.

The chief active principle is an alkaloid—aconitine ($C_{33} H_{43} NO_{12}$), of which 1 per cent is extracted by a tedious process from the powdered root by rectified spirit. It is colourless, usually amorphous, crystallisable with some difficulty in right rhombic prisms, markedly alkaline; soluble in 150 parts of cold water, 50 of hot water, and more readily in alcohol, ether, and chloroform. Commercial aconitine is probably a mixture of several alkaloids, and is apt to be irregular in strength. The crystalline is purer than the amorphous; the English is generally more active than the Continental; Morson's is more uniform than that of most other makers. Other alkaloids have been separated: pseudo-aconitine, which Professor Fraser states paralyses especially the respiratory, while aconitine more notably paralyses the circulatory centres; and aconella, isolated by Messrs T. & H. Smith of Edinburgh. Napellin and several bitter substances have also been isolated. The basic bodies are united with aconitic acid ($C_6 H_6 O_6$), which is present in all parts of the aconites, in larkspur and in equisetum, and is separable in colourless laminæ. The composition of aconite requires, however, more investigation, and its several active principles further examination.

Actions and Uses. — Aconite slightly and temporarily stimulates and then paralyses sensory nerve-endings, producing local tingling and numbness. It slightly stimulates and shortly **paralyses** the nerve centres of the spinal cord and medulla, acting specially as a cardiac and respiratory sedative. The sensory centres are earlier and more prominently affected than the motor. Death results from arrest of respiration. It is prescribed in febrile conditions and acute local inflammations, and is topically applied to relieve pain.

General Actions.—The transient stimulation and subsequent more abiding **paralysis of the peripheral ends of**

sensory nerves, causing first tingling and then numbness, are produced, whether the drug be applied to the skin or a mucous surface, or is carried in the circulation throughout the body. The primary stimulation is the chief cause of the increased secretion from the salivary and perspiratory glands, as well as of the retching, and other evidences of gastric irritation. The motor nerve-endings are not so prominently affected, but the fibrillary twitchings of muscles testify to their irritation.

Aconite is **rapidly absorbed** from the stomach within four minutes, and rapidly passes into the tissues, as is shown by the fact that the blood of a poisoned dog, a few minutes after the drug is swallowed, may with impunity be transferred into another dog (Phillip's *Materia Medica*).

Paralysis of the sensory centres of the spinal cord and medulla is promptly and notably produced. The sensory vagus roots are quickly implicated, **lowering the strength, volume,** and **frequency of the heart action.** The paralysis involves the vaso-motor centres, and the pulse becomes further weakened and less regular, while blood-pressure is lowered. The dilatation of the arteries increases the capacity of the vascular system, and the patient, as Dr Fothergill aptly puts it, "bleeds into his own vessels," and sometimes with consequent relief of limited inflamed parts. The reflex power of the cord is diminished. The motor centres at first stimulated, producing clonic convulsions, are shortly paralysed, but neither so early nor so fully as the sensory centres. The muscles are slightly, if at all, affected. From enfeebled circulation, and also from **paralysis of the respiratory centre,** dyspnœa occurs. Respiration, which is at first slow, deep, and effected with expiratory effort, becomes more shallow and laboured. Imperfect nutrition of nerve-centres determines great muscular weakness, and temperature is lowered. Convulsions, mainly due to asphyxia, sometimes precede death, which generally results from **stoppage of respiration.** Neither brain nor special senses are affected. The pupils, sometimes dilated, sometimes contracted, during the earlier stages of poisoning, remain dilated in the later. Aconite is **removed** from the body chiefly **in the urine,** augmenting both its fluid and solid parts.

Toxic Effects.—Aconite exerts tolerably uniform effects on all animals. **Horses** receiving an overdose, such as one to two drachms of the B. P. tincture, tremble violently, lose the power of supporting themselves, become slightly convulsed, froth at mouth, perspire freely, appear much nauseated, and make efforts as if about to vomit; the breathing in half an hour becomes slower and feebler, the pulse is reduced in strength, and usually in number; six or eight hours elapse before the breathing and pulse become normal. Impaired appetite and more or less nausea occasionally remain for one or even two days. Viborg mentions that a horse, after receiving eight ounces of the root and lower leaves of Aconitum Napellus, became very uneasy, breathed slowly and with difficulty, attempted to vomit, had a depressed, irregular, intermittent pulse, and looked round at his flanks, as if suffering pain; but he gradually recovered in about six hours. Next day he got three-quarters of a pound of aconite, which caused like effects, and death in about twelve hours (Hertwig).

Similar symptoms were observed in the following experiments, made at the Edinburgh Veterinary College, many years ago, by my lamented friend Mr Barlow and myself: A black mare, 15½ hands high, previously used for slow work, and in good health, got, at 12.40 P.M., one fluid drachm of Fleming's tincture of aconite. At 1 she was nauseated, had eructations of frothy mucus, with attempts to vomit, which increased till 1.30, when she went down. The pulse, which was 35 before the administration of the poison, was now 60, and very weak; she continued down till 7 P.M., when she was destroyed in consequence of being unable to stand.

An aged chestnut cab horse, 16 hands high, and useless from a bad quittor, was tied up by the head for ten minutes, to insure perfect quietude. The pulse was then found to be 56, and the respirations 12. The animal had a good appetite and regular evacuations. At ten o'clock he got ninety minims of Fleming's tincture of aconite in a linseed-meal ball, the head being still kept tied up for fifteen minutes. In half an hour he fed greedily on potatoes and beans, but no change was observable. At 1 P.M. he got fifty minims of the same tincture in four ounces of water. At 1.15 he appeared to be making

continual efforts to swallow something; his mouth was closed; and after such attempts at swallowing, air and fluid were regurgitated up the gullet, causing a rattling noise, as of air-bubbles mixed with water. At 1.20 the pulse was 50; symptoms of actual nausea appeared; the muscles on the side of the neck and throat were contracted; the muzzle brought near to the breast; the lips retracted; and the mouth slightly opened. Fits of retching came on every two minutes and increased in violence during the next ten or fifteen minutes. 1.30.—During each paroxysm of retching the mouth was opened, the lips widely retracted, and four or five ounces of frothy mucus discharged on the ground. The pulse had fallen to 40, and become weak. On account of the retching, the respirations could not be counted. Copious perspiration broke out over the body; the mucous membrane of the mouth, nose, and eyes were pallid, and there were fibrillary twitchings of the muscles, especially about the head and neck. 2 P.M.—Pulse 38, and weak; the respirations not easily counted, but probably about nine; in other respects no change. The animal passed fæces and urine freely; and shortly after getting a pint of cold water, lay down somewhat relieved, with the retching scarcely so frequent. At 2.30 the pulse was weaker than ever; the breathing irregular, interrupted, and sighing; and the animal unable to rise. The labial and nasal muscles were contracted, causing retraction of the lips, and disclosing the gums blanched, and the teeth covered with frothy mucus. Two bottles of strong ale were given, with half an ounce of spirit of ammonia. At 3 P.M. the pulse was 35, and still weaker than before; respiration was somewhat accelerated, probably owing to the animal's being down; perspiration continued to stream from every part; and the retching, though somewhat subsided, still came on about every ten minutes. The animal remained down without much change until about 6, when the nausea was somewhat diminished, but the pulse so weak as to be scarcely perceptible. He was raised with difficulty, and stood blowing much for fifteen minutes. At 7 there was little change, the pulse remained imperceptible, the respirations about 20, and there was no appetite for food or drink. He was left with the expectation of finding him dead next morning;

but at 7 A.M. he was up and eating. His pulse was 65, his respirations 10, and his appearance very haggard and reduced. He continued in much the same state for a week, never regained his former look or appetite, for two days was unable to rise or stand, and became much wasted. He was destroyed by six drachms of prussic acid; but, on post-mortem examination, every part except the lungs seemed healthy. These organs, more especially the right one, were extensively studded with patches of extravasated blood about the size of walnuts, which, in those parts connected with the pulmonary tissue, were more or less softened, and emitted an odour characteristic of heated decomposed blood. The rusty fluid produced from the softening had in various places passed into the bronchi, imparting to their frothy mucus a brown colour.

The following experiments on **cats and dogs** were made at the Edinburgh Royal (Dick's) Veterinary College many years ago. A cat of average size got seven minims of Fleming's tincture of aconite. In two minutes severe retching came on, with a copious flow of saliva, probably arising from paralysis of the fauces; and in five minutes painful vomiting and involuntary muscular contractions of a most active kind, with perverted action of the voluntary muscles, causing the animal to leap up the wall and turn somersaults backwards. In this, as in most other cases, the pupil, at first somewhat contracted, ultimately became dilated. The pulse was reduced in volume and strength, shortly becoming very weak; the breathing was gasping. The vomiting and inordinate muscular action continued until within two or three minutes of death, which took place twenty minutes after the administration of the poison. No morbid or peculiar post-mortem appearances were observable.

A medium-sized Scotch terrier got thirty minims of Fleming's tincture In five minutes painful and active vomiting came on, which must have effectually emptied the stomach. The retching and vomiting continued, however, for half an hour, when the animal was so exhausted and paralysed in its hind extremities as to be unable to walk except by supporting itself on its fore limbs and dragging the hind after it. It gradually recovered, however, in about two hours. In some other cases

a drachm of Fleming's tincture has destroyed dogs with as much rapidity as an equal quantity of medicinal prussic acid. The lungs after death are found to be shrunk, and contain little blood; the trachea and bronchi contain excess of frothy mucus, accumulating owing to paralysis of the respiratory muscles and glottis; the cavities of the right heart are greatly distended with blood; the left side is nearly empty; but nothing abnormal is noticed about the digestive organs.

In ruminants aconite, introduced into the stomach, is rather less prompt and powerful than in horses and dogs; and the late Professor Fleming found its activity was diminished by digesting it with the gastric secretions either of rabbits or calves. But when injected into the veins or areolar tissues, it affects ruminants as readily as other animals.

Antidotes.—If the patient is seen immediately after swallowing the poison, endeavour should be made to empty the stomach by an emetic or the stomach-pump. Alcoholic and ammoniacal stimulants are given. Ether should be used hypodermically. Atropine, and to a limited extent digitalin, also antagonise the sedative effects of aconite on the heart and breathing, and atropine is accordingly used hypodermically. Warmth and infriction into the chest-walls of some stimulating liniment also assist in maintaining cardiac and respiratory action.

Medicinal Uses.—Within ten or fifteen minutes after a medicinal dose is given, the **pulse-beats** are **lowered** sometimes one-fifth in number, and are diminished in strength and volume; within an hour or two, abnormal **temperature** is also **lowered,** while **perception of pain** is notably **lessened.** In virtue of these physiological actions, carefully regulated doses relieve the **febrile condition,** and combat **acute local inflammation** in robust patients, in the earlier stages of pleurisy, enteritis, peritonitis, mammitis, lymphangitis, laminitis, and acute rheumatism. Acute sore throat in horses, accompanied by high fever, is sometimes controlled by a moderate dose, followed at intervals of an hour by half-doses, repeated until five or six are given. In the more common epizootic sore-throat, accompanied as it generally is by typhoid symptoms. aconite is useless—and indeed injurious. Although serviceable in acute

sore throat, laryngitis and pleurisy, it is too reducing a remedy to be used in most cases of bronchitis or pneumonia.

Conjoined with a purgative, aconite is sometimes prescribed in spasmodic colic. **In enteritis** in horses, Mr Hill of Wolverhampton has stated that, within five minutes after aconite tincture is swallowed, he has repeatedly found the pulse fall from 100 to 70 beats per minute, and this notable effect is usually succeeded by gradual abatement of fever and pain.—(*Veterinarian* for July 1871). The late Professor Robertson was wont to prescribe in enteritis ♏ v. Fleming's tincture, ʒ½ each of camphor and powdered opium, administered in a pint of gruel.—*(Equine Medicine).* Professor Williams recommends it in horses in pleurisy and pneumonia, where pyrexia is considerable, but does not find it so serviceable in these complaints amongst dogs.—*(Principles and Practice of Veterinary Medicine).* In **acute rheumatism** it usually relieves both febrile symptoms and local pain. Mr Connochie, Selkirk, in the treatment of acute rheumatism, after a dose of physic conjoined with opium, recommends thrice daily, for either horses or cattle, ♏ x. Fleming's tincture and a drachm of nitre. Repeated small doses are beneficial in the outset of **puerperal peritonitis** in cattle; and some flockmasters now use aconite tincture with success during the lambing season, giving it with gruel to all ewes which have a hard time, begin to blow, or show febrile symptoms. Conjoined with perfect quiet and a dose of physic, a few small doses of aconite have been used in the earlier stages of tetanus by Mr Thomas Dollar, London, by Mr Hill, Wolverhamptom, and Mr Macgillivray, Banff.—(*Veterinarian*, 1871). In small, frequently repeated doses, either alone or with hemlock, it usually controls and steadies excessive or irregular action of the hypertrophied heart, especially in plethoric patients. Although administered for other purposes, it frequently expels intestinal worms.

Paralysing sensory nerves, aconite is **used externally** as a local anodyne in neuralgic and rheumatic affections, and in swollen and painful joints. As with other anodynes, it is more effective in combating irritative than inflammatory pain. It frequently relieves the itching of grease and other eczematous

eruptions in horses and dogs. More rapid absorption and greater anodyne effect are secured by adding a little chloroform to the aconite tincture or liniment. The external use of aconite, it must be remembered, demands as much care as its internal use.

Doses, etc.—The plant is not used in the crude state. The **extract,** unless very carefully made from an alcoholic solution, is apt to be of defective or irregular strength. The **B. P. tincture,** prepared from the root by digestion and subsequent percolation, and convenient alike for internal and external use, is occasionally of uncertain and insufficient strength; and, to prevent disappointment, should be obtained only from trustworthy sources. For horses, the dose varies from ♏xx. to ♏xxx.; for cattle, fʒ$\frac{1}{2}$ to fʒi.; for sheep and pigs, ♏v. to ♏x.; for dogs ♏i. to ♏v. **Fleming's tincture,** still much used in veterinary practice, is about four times as strong as the B. P. tincture, and, on account of its concentration, requires to be used very carefully. The dose for horses is from ♏iv. to ♏x.; for cattle, from ♏v. to ♏xii; for sheep, ♏ij. or ♏iij.; and for dogs, from ♏$\frac{1}{2}$ to ♏j. Whichever tincture is used should be given in several ounces of cold water. The effects of full doses sometimes continue for twelve or fifteen hours. Small and repeated are preferable to larger doses at longer intervals. The first may be a full dose, and may be followed by six or eight half-doses repeated, as the case appears to require, ar intervals of from half an hour to two hours. The antipyretic effects which should thus be produced are usually kept up by salines and other treatment. Used hypodermically, less than half the above quantities suffice. Professor Walley finds that the activity of aconite is increased by giving it in combination with alkaline carbonates.—(*Veterinarian's Pocket Conspectus*).

Aconitine is one of the most potent of sedative poisons. Dr Headland (*The Action of Medicines*) records that $\frac{1}{300}$th of a grain in solution in water suffices to destroy a mouse; $\frac{1}{100}$th of a grain kills a small bird after a few minutes, and $\frac{1}{50}$th almost instantaneously; $\frac{1}{20}$th to $\frac{1}{10}$th kills cats, the latter quantity in twenty minutes or half an hour; $\frac{1}{2}$ grain, given to a shepherd's dog weighing 30 lbs., began to operate in three or four minutes, and proved fatal in sixty-five minutes; $\frac{1}{20}$th

grain subcutaneously injected over the scapula of a horse caused in a few minutes champing of the teeth, salivation, fits of retching, reduced number and force of the heart's action (Mavor and Burness on *Action of Medicines*); $\frac{1}{25}$th of a grain would probably suffice to cause the death of an adult man. Used subcutaneously, especial caution must be had, as it acts even more rapidly and powerfully than when given by the mouth The symptoms and post-mortem appearances are the same as in poisoning with the crude drug, the extract, or the tincture. In human practice, the alkaloid is used chiefly externally, in the forms of alcoholic solution and ointment.

ALCOHOL.

The more important mono-hydric alcohols used in medicine and pharmacy are:—

Methyl-alcohol	CH_3. HO	from	distillation	of wood.
Ethyl ,,	C_2H_5. HO	,,	fermentation	of grape sugar.
Propyl ,,	C_3H_7. HO	,,	,,	,, grapes.
Butyl ,,	C_4H_9. HO	,,	,,	,, beet.
Amyl ,,	C_5H_{11}.HO	,,	,,	,, potatoes.

These alcohols are hydrates of the radicles of the methane or marsh gas series (CH_4). In their production, the radicle has one of its atoms of hydrogen (H) displaced by an atom of the radicle hydroxyl (HO). Thus methane (CH_4) losing one atom of H, and assuming one of HO becomes CH_3. HO, or methyl-alcohol, popularly known as wood spirit. Ethane (C_2H_6) losing one atom of H, and taking up one of HO, becomes C_2H_5.HO, ethyl-alcohol, or spirits of wine. Each of these alcohols when oxidised by removal of H_2, in the form of a molecule of water (H_2O), yields an aldehyd; while by substitution of HO for H, the aldehydes are converted into an acid. Thus ethyl-alcohol ($CH_3.CH_2.HO.$) is converted into aldehyd ($CH_3.COH$), and thence into acetic acid ($CH_3.CO.\ OH$). In each of the alcohols, moreover, the H in the HO can be replaced by an alcohol radicle, when an ether is formed, thus ethyl-alcohol ($C_2H_5.HO$) yields common ether ($C_2H_5.O.C_2H_5$).

Methyl-Alcohol.—In the destructive distillation of wood, the distilled products separate into two layers, the lower consisting of wood-tar, the upper of impure methyl-alcohol, pyroligneous acid, acetone, methyl-acetate, and other bodies. On subsequent redistillation of the upper layer with chalk, the acetic acid is retained in the still as calcium acetate. The distillate is the yellow empyreumatic **wood naphtha,** which is now largely used for making varnishes. Repeated distillation, and treatment with quicklime remove acetone, higher ketones, and malodorous pyroligneous substances, leaving methyl-alcohol. This spirit is now also prepared in large quantities from beet-sugar refuse.

It has many of the properties, and is applied to many of the purposes of ethyl-alcohols. It is very inflammable, burning with a pale flame, has a specific gravity of ·799, boils at 140° Fahr., and has an empyreumatic odour, depending upon the presence of oily matters. From ethyl-alcohol it is distinguished by heating with sulphuric acid and potassium dichromate, when it yields formic acid; while ethyl-alcohol similarly treated yields acetic acid. Silver ammonia nitrate, when warmed with formic acid, is reduced to the metallic state, but it is not affected by acetic acid.

Ethyl-Alcohol is found in small amount in some unripe fruits, in coal-tar, and other products of the distillation of wood, while traces have been distilled from the bodies of rabbits and other animals which have never tasted alcohol, but in which is is probably formed by the breaking up of hepatic sugar. (Phillip's *Materia Medica and Therapeutics).* It can also be got synthetically. It is chiefly obtained, however, from the fermentation of glucose or grape sugar ($C_6H_{12}O_6$). Starch ($C_6H_{10}O_5$) contained in barley, maize, rice, and other grains, or in potatoes, is the cheapest source of sugar, and hence of alcohol. When heated with very dilute sulphuric acid, or mixed with infusion of malt, starch takes up a molecule of water (H_2O). By a similar appropriation of water, cane-sugar, which is not directly fermentable, is converted into grape-sugar ($C_{12}H_{22}O_{11} + H_2O = 2[C_6H_{12}O_6]$). The saccharine solution is treated with **yeast**—the torula cerivisiæ, which finds fitting nutriment in the albuminoid materials present in

ordinary sugars, rapidly multiplies, and decomposes about 95 per cent. of the glucose into alcohol and carbonic acid:—

$$C_6H_{12}O_6=2(C_2H_6O)+2(CO_2).$$

There are besides produced traces of glycerin and succinic acid. The action of the yeast is stopped when the alcohol reaches 20 per cent. and fermentation does not occur below 32°, or above 95° Fahr.

The weak impure spirit thus obtained, when concentrated and purified by repeated distillations, attains the specific gravity ·825, which, according to the British excise standard, constitutes alcohol or pure spirit. Seven to ten per cent. of water are still, however, retained, which, though inseparable by distillation, may be removed by digestion with such water-absorbing bodies as potassium carbonate and quicklime, and subsequent cautious distillation. **Absolute** alcohol, thus obtained, is a mobile, colourless fluid, with a spirituous odour, an intensely fiery taste, and the specific gravity ·794. It is entirely volatile, burns without smoke, boils at 78·3°, freezes at — 130·5° C. It has great affinity for water, takes it from any substances with which it is in contact, and thus exerts its notable power of preserving both vegetable and animal matters. Next after water it is the most universal solvent.

There are two good **tests** for ethyl-alcohol, (1) to the suspected liquid add hydrochloric acid, and sufficient potassium red chromate to colour it orange yellow, and boil. If alcohol be present the fragrant odour of aldehyd will be perceived and the liquid will become green from production of chromic chloride (Co_2Cl_6). (2) The liquid is gently warmed, a little solid iodine is added and weak potash solution, until bleaching occurs on stirring; iodoform in yellow crystals is precipitated, identified by its saffron-like odour.

RECTIFIED SPIRIT, spiritus rectificatus, or spirit of wine, are the terms applied to the alcohol obtained from distillation of fermented saccharine fluids. It contains 16 per cent. by weight, or 11 per cent. by measure, of water, and has the specific gravity ·838. To absolute alcohol it bears general resemblance, but has less pungency and volatility, and a higher boiling point. It dissolves iodine, bromine, oils, gum-resins, most

alkaloids, most deliquescent salts, excepting potassium carbonate, but not efflorescent salts, nor salts sparingly soluble in water. It is used for making all the spirits, and a large number of the tinctures and extracts of the Pharmacopœia.

Proof Spirit, the spiritus tenuior of the B. P., is directed to be made by mixing five pints of rectified spirit with three pints of water. Thus prepared, it is freer from impurity than the weak, imperfectly rectified spirit of the shops; it contains 49 per cent. by weight, or 57 per cent. by volume, of absolute alcohol, has the specific gravity ·920, and is used for the preparation of many tinctures. The specifie gravities of spirits and other such fluids are generally determined with a hydrometer or with marked beads.

Methylated Spirit is a mixture of 90 parts of rectified spirit, with 10 parts of the pungent disagreeable-flavoured wood spirit or impure methylic alcohol. This mixture is unfit for drinking, and is sold free of duty for pharmaceutical and other manufacturing purposes.

The following alcoholic fluids, employed dietetically and medicinally for man, are occasionally also prescribed for the lower animals:—**Wine**, the fermented juice of the grape, contains from 8 to 17 parts of excise alcohol (·825), and owes its peculiar bouquet to traces of fragrant ethers; **Brandy**, prepared by distillation of the weaker wines, contains about 53 per cent. of excise alcohol; **Rum**, a fluid of about the same strength, is made by distillation of a fermented solution of molasses; **Whisky**, of similar strength, is obtained by distilling a thoroughly fermented solution of malt, or of malt and raw grain; while **Hollands, Geneva**, and **Gin**, a little weaker than these, are prepared from fermented malt, with a small quantity of juniper berries. **Ales** and **Porter** are made by infusing malt in water at about 180° Fahr., allowing it to stand for a few hours until the starch is in great part converted into dextrin and sugar; boiling the solution with the requisite hops; and adding yeast to cause fermentation, which, however, must be carefully prevented from going too far. The dark colour of porter depends on a part of the malt being roasted. Porter and ales contain between 4 and 8 per cent. of excise alcohol.

Propyl-Alcohol, or ethyl-carbinol, is obtained from the later portions of the distillate in the rectification of crude spirits of wine.

Butyl-Alcohol is got from the fermentation of beet-sugar refuse, and also from the distillation of crude spirits.

Amyl-Alcohol or fousel oil is present in all crude ethyl-alcohols, is specially obtained from the distillation of potatoes and is distinguished by its offensive flavour. It is sparingly soluble in water, but readily dissolved in other alcohols, ether, and essential oils. When oxidised, it yields valerianic acid. It is used for the manufacture of amyl-nitrite.

Actions and Uses. — The monobasic alcohols, in large doses, paralyse nerve-centres, lower temperature, and kill chiefly by paralysis of respiration. Ethyl-alcohol, in its several forms, is used as a diffusible stimulant, antiseptic, antipyretic, and readily assimilable food, and as a carminative, antispasmodic, diuretic, and diaphoretic. Both ethyl and methyl-alcohols are local irritants, refrigerants, and antiseptics, and are employed as preservatives of vegetable substances, and as solvents.

Toxic Effects.—**Large doses paralyse the nerve-centres** in the inverse order of their development, the cerebral being first affected, the cardiac and respiratory last. Their effects are generally divided into four stages—(1) stimulant, (2) narcotic, (3) anæsthetic, (4) and paralytic. With ethyl-alcohol these stages are usually distinctly marked. With methyl-alcohol the excitement is more intense, the subsequent stages follow more rapidly, but if the doses are not lethal the effects pass off more quickly. With œnanthic and caprylic, which are non-fermented alcohols, the stages are less regular, and are marked by convulsions. Ethyl or methyl-alcohols are not so deadly as most of the others. Their **toxic dose** is 8 grammes to the kilogramme of the live weight of an animal. The toxic dose of propyl-alcohol is 3·9 grammes; of butyl, 2·0 grammes; of amyl, 1·7 grammes (*Brunton*). The toxic dose of all crude spirits is less than that of the same spirit after rectification, and such impure spirits produce greater excitement and heavier stupor.

Different classes of animals are somewhat differently

affected by alcohol. Man, whose intellectual centres are about eight times larger than his motor centres, has his intelligence quickly acted on by doses which are insufficient to impair his motor functions. Amounts corresponding to 0·4 to the 1000 of the total weight of the body disturb human intelligence; while 2·40 per 1000 of weight are needed to impair motor functions. In dogs the cerebral are about five times the weight of the motor centres. Alcohol has no notable effect until 1·5 to the 1000 of body weight is taken, and the prominent results then occurring are disturbance, not of intelligence, but of motor function. Horses and cattle receiving full doses exhibit like excitement and perversion of motor function; they prance, strike with the feet, are unsteady in their gait, and drag the hind limbs. Muscular twitching and convulsions occasionally occur.

Large concentrated doses produce rapid narcosis with a minimum of preliminary excitement. Hertwig gave an old but sound **horse** eight ounces of alcohol of specific gravity ·825. He became much excited and uneasy, pranced, staggered, and after two minutes fell, struck out vehemently with his feet, rolled his eyes—the pupils at first were contracted, but afterwards were dilated. He rapidly became insensible, and died in about ten minutes. The heart continued to beat for several minutes after death. Four to six ounces produced similar motor excitability, but did not prove fatal *(Arzneimittellehre)*.

Dogs about 20lbs. weight, swallowing quickly four or five ounces of whisky, if it is retained, speedily and without any appreciable excitement become comatose, and die within a few minutes. Dr Percy injected strong alcohol into the empty stomachs of dogs, which almost immediately fell over insensible; respiratory and cardiac movements ceased within two minutes; the blood was found charged with alcohol. Similar sudden fatal paralysis occurs in men swallowing quickly full draughts of spirits (*Christison on Poisons*). Dogs receiving one to two ounces of rectified spirit, when the œsophagus is ligatured, become uneasy, endeavour to vomit, are unable to control their movements, become comatose, and die in periods ranging from a quarter to half an hour. One to two drachms

induced in dogs reeling and stupor, which continued for about half an hour.

Cattle and sheep, and indeed all ruminants, are less susceptible to the actions of alcohol than dogs or even horses. Hertwig mentions that when brandy is given to sheep and goats, they soon become fond of it, taking six or eight ounces at a time, and gradually becoming less easily affected by it.

Chronic poisoning by alcohol, with impaired nervous power and fatty degeneration, common in human patients, is unknown in the lower animals; but Professor John Gamgee describes *(Domestic Animals in Health and Disease)* a form of encephalitis in cattle, resulting from alcoholism, due to the practice "prevalent in some parts of Scotland, of giving 'burnt ale' to cows in the neighbourhood of distilleries. The ale is given by steeping straw in it, and the animals will also drink it freely. They often sleep soundly after such a beverage, and intoxication is not infrequent. The symptoms are as follows:—The head is turned singularly to the side, and is slightly elevated. The pupils are widely dilated, and the eyes have a remarkably wild appearance. On approaching the animals they wink rapidly and tremble. There is marked heat of head, horns, and ears. When pressed with the finger in the axilla, they fall instantly, and when pulled by the head, they incline to turn over. The pulse is about seventy or eighty per minute. After death all the organs are found healthy except the nervous centres, and both the brain and its membranes are found congested. This congestion often extends into the spinal canal, and the pia mater over both brain and cord is the seat of red spots; the redness is either ramified, or is obviously due to blood extravasation. Clots of blood have been found in the lateral ventricles, and around the spinal marrow in the cervical region. There is evidently softening of the brain substance, as a direct result of this condition." At distilleries, where the live stock are freely supplied with the dreg or wash and other refuse containing spirit, pigs, as well as cattle, are frequently intoxicated, exhibit symptoms similar to those described, and are sometimes fatally affected.

The antidotes are tea and coffee, cold douches, and other means of warding off the deadly stupor. Strychnine and

alcohol are mutually antagonistic, and alcohol, used hypodermically, restores rabbits apparently dead from the alkaloid.

GENERAL ACTIONS.—**Ethyl-alcohol** in one or other of its several forms is the alcohol almost invariably used in medicine. Tolerably concentrated solutions withdraw water from albuminoid solutions, and precipitate them. Applied to the mucuous surfaces, or to the skin, they act in a similar manner, precipitating a thin white pellicle of albumin, and thus exerting slight **astringent** effects. Owing to its evaporation when applied to the skin alcohol causes a **sensation of cold,** but if evaporation be prevented by a covering of oiled silk, it passes through the skin, inducing a sensation of warmth. A similar warming effect is produced in the mouth and stomach when alcohol is swallowed.

Alcohol, if not too concentrated, is **readily absorbed** through any of the ordinary channels of administration. Orfila poisoned dogs by causing them to breathe air charged with it. Being highly diffusible, it quickly enters the blood. It appears to form with the hæmoglobin a compound of diminished capacity to take up and give off oxygen. Full or large doses, accordingly, **interfere with oxidation** of blood and tissue. Circulation is quickened; even moderate doses in the first instance increase the strength and frequency of the pulse. The functions of **nerve centres** generally **are stimulated,** causing sometimes a slight temporary rise of external temperature, seldom exceeding, either in man or animals, half a degree. Quickly, however, there follow dilatation of cutaneous vessels, and consequent lowering of temperature.

Observations on various classes of animals demonstrate that alcohol in full doses **lowers animal temperature.** This mainly results from (1) lessened oxidation; (2) increased circulation, and consequent increased evolution of heat; and (3) vaso-motor paresis. As with most of the other effects of alcohol, the lowered temperature is not, however, of long duration. Magnan has shown that puppies lose 3° to 7° F. when alcohol was added to their food. "The experiments of Binz and Bouvier on septicæmic fever in animals gave singular results. In rabbits, for instance, after injecting septic fluid, and inducing a febrile reaction ranging from 102° to 105° F., about three

drachms of alcohol diluted with water were introduced into the stomach by means of a sound; fifteen minutes afterwards the temperature was 104·1°, in forty-five minutes 102·4°, in ninety minutes 100·9°, in two hours and a half 100·6° F. The following day the pyrexia returned, and increased till the death of the animal. Very large doses lower the temperature as much as 8·5 C.. and if narcosis was induced before fever began, quite prevented its development" (Phillip's *Materia Medica).* Dr B. W. Richardson's experiments also shew that doses sufficient to cause unconsciousness, dangerously reduce temperature of birds to the amount of 5°, of dogs 3°, of rabbits 10°, and of man himself 2° to 3° F. (*Cantor Lecture* 1874).

Digestion and nutrition are improved by small, but injured by large doses. A diminution is noted in the carbonic acid discharged from the lungs. There is notable increase in the secretion of urine, and an increase in the proportion of urinary solids. Dr George Harley found that half an ounce of alcohol, with an equal quantity of water, injected into the portal vein of dogs, so seriously interfered with the glycogenic functions of the liver that the urine within three hours became diabetic. Of medicinal doses, mere traces are removed by the lungs, skin, or kidneys, and by far the **larger proportion undergoes combustion** in the body, and, like other hydrocarbons, and especially when used with suitable food, alcohol becomes a **source of heat and vital energy.** Schulinus' experiments on these points are conclusive, and have been repeatedly verified. Animals receiving measured quantities of alcohol, so soon as full effects were produced, were killed by bleeding and insoufflating air into the vessels. Fractional distillation of the blood and viscera were made separately, and repeated investigations have demonstrated—(1) "That alcohol does not localise itself in any particular organs, such as the brain or liver, but diffuses itself equally in the system; (2) that only the blood contains proportionately more than other tissues; (3) of the alcohol taken, the greater part is decomposed within the organism, and the amount eliminated by the lungs, skin, and kidneys is insignificant" *(Phillips).* Professor Binz' experiments shew that not quite three per cent. of the alcohol consumed is excreted unchanged.

The **dietetic value** of alcohol has been the subject of much controversy. Its consumption in great part within the body explains how men and animals kept on somewhat deficient diet, on which weight would be lost, nevertheless maintain their weight, when receiving, in addition, daily small doses of alcohol. But for ordinary nutrition, it is a food which, although quickly assimilated, is rapidly used up, and unless carefully employed, has the disadvantage of impairing oxidation and excretion. For permanent repair of waste, and maintenance of strength during severe continued exertion, it cannot compare with suitable albuminoid food. This was strikingly illustrated in the Ashantee War, when soldiers, on exhausting marches, who received rations of rum, although temporarily recruited, soon flagged again; while those receiving beef-tea were equally refreshed in the first instance, and did not experience the secondary depression which overtook those who preferred the spirit.

Medicinal Uses.—Few remedies are more frequently and extensively used than the several forms of ethyl-alcohol. **They stimulate** gastric secretion, and improve appetite in atonic indigestion; they act as carminatives in flatulence; control the spasms of intestinal colic; and check persistent diarrhœa, especially when conjoined with sodium benzoate or creasote. They equalise irregular circulation in chills, and antagonise cardiac feebleness resulting from debilitating disease, poisoning by sedatives, snake bite, or shock. Many cases of puerperal fever in cows, when stupor is approaching, or even during the earlier excitable stages, are benefited by five or six ounces of whisky given at intervals of one to two hours. Where such draughts cannot be swallowed, they are sometimes introduced into the rumen by a stomach-pump; but where coma has set in, stimulation needful to maintain heart and respiratory action is best effected by subcutaneous injection of ether.

In **epzootic catarrh** and **sore throat** amongst hard-worked horses, when the pulse is quick and weak, the breathing hurried and embarrassed, and the temperature above 102° F., no treatment is more successful than a couple of ounces of spirits diluted with gruel or water, repeated every two or three

hours; a saline draught administered thrice daily; the body well clothed, and mustard, if need be, applied to the throat. Many cases of bronchitis and pneumonia, after a few days' illness, and especially during the period when inflammatory products are being absorbed, are benefited by moderate, frequently repeated, doses of spirits. The restorative sustaining power of alcohol after the earlier stage of such disorders is well illustrated by a case of double pneumonia communicated by Mr Israel Print, of Clapham. The horse seen after 48 hours' illness was in a state of serious distress and prostration; his pulse 100, and scarcely perceptible; his respirations, 52; his temperature, 106°. He was ordered a wine-glass of whisky every two hours, and took 27 ounces in 24 hours. His pulse had then fallen to 84, his respirations to 46, his temperature to 104°. The frequent doses of spirit were persevered with for another day, with continued abatement of fever and distress, and the animal made a good recovery.

The **antiseptic** and **antipyretic** actions of alcohol are notably exhibited in septicæmia and pyæmia, howsoever produced. This is well illustrated by an experiment of Professor Binz, who produced septic fever by injection of pus in two young healthy dogs of equal weight, one of which, treated with three doses of two drachms each introduced into the stomach, shortly recovered, while the other, which remained without treatment, died on the second day. His experiments with rabbits, above quoted, also testify to the notable antipyretic effects of alcohol. Not only does it lower exalted temperature, but in such cases it also helps to maintain the failing cardiac action, and tides over critical nervous depression. It is, hence, serviceable in horses fevered and enfeebled with protracted strangles abscesses, and reduced by purpura; in all animals suffering from puerperal metritis; and in dogs exhausted from distemper; as well as in most other forms of blood-poisoning In all patients during **convalescence from reducing disorders,** as well as in chronic cases connected with or tending to malassimilation, alcohol is serviceable as a gastric and general stimulant, and as a readily assimilable food. Young cattle as well as other anæmic subjects are frequently treated with sound ale or spirits and water, conjoined with iron salts. Tubercular

patients are often benefited by alcoholic drinks and oleaginous food.

The more important medicinal **effects follow** within **ten or fifteen minutes after administration.** There is, hence, little difficulty in determining whether the remedy proves beneficial or the dose is suitable. As already indicated, the weak pulse should become stronger and firmer, the quick pulse slower, breathing should be more natural, the skin more moist, and temperature lower—in a word, there should be remission of the more prominent morbid symptoms. If such favourable conditions are not produced, the alcohol is probably not the suitable remedy, or is not being used in suitable dose. When **unsuitable,** or given too frequently or too largely, whether in health or disease, alcohol hinders oxidation, retards excretion, impairs digestion, and causes dryness of skin and mucous surfaces.

Alcohol **resembles** in its actions and uses the volatile oils, ethers, and ammonia, and is frequently prescribed with one or more of these allied remedies.

External Uses.—Rubbed into the skin, alcohol, in a state of concentration, acts as a **rubefacient.** Coagulating albumin, it is occasionally applied **to arrest bleeding.** Beat up with white of egg, it is used in veterinary as well as in human practice, to harden the epidermis and prevent excoriation of parts exposed to pressure. Weak solutions, conjoined with a half to one per cent of carbolic or salicylic acid, exert **anodyne** effects, relieving itching in erythematous and other skin diseases. Nettle-rash is often treated with dilute spirituous solutions, to which one per cent of petroleum benzene is usefully added. For surgical purposes it is employed as a **refrigerant** and **antiseptic.** Dr Jonathan Hutchinson keeps amputations, compound fractures, and other wounds moist with six parts absolute alcohol, half a part liquor plumbi, and sixteen parts distilled water. As a stimulant and refrigerant for bruises, wounds, and strains, it is popularly used throughout Scotland in the familiar form of whisky-and-water. A cooling lotion is made with an ounce each of rectified spirit, vinegar, and ammonium chloride, dissolved in a quart of water. As a refrigerant, however, ice is generally more convenient and

effectual. A convenient, well-keeping **solvent** for the active principles of many drugs, alcohol is largely used for making tinctures and extracts.

Doses, etc.—Of rectified spirit horses take about f℥i.; cattle, f℥j. to f℥iij.; sheep, f℥ss; pigs, fʒij.; and dogs, about fʒj. Whisky, gin, and brandy, as already indicated, are about half the strength of rectified spirit; sherry and port, sometimes prescribed for foals, calves and dogs, are about one-third the strength of whisky; while good ale is about half the strength of these wines. The suitable doses and the frequency of their repetition are mainly determined by the condition of the patient, and the purpose they are intended to serve. They act promptly, but their effects are transient, and require to be maintained by frequent doses, repeated, in critical cases, at intervals of one or two hours. They are less apt to excite or disagree if administered along with food. Properly diluted, they are voluntarily drunk by most patients. Mixed with linseed gruel, there is little risk of their misappropriation.

To **determine or intensify** one or other of the effects of alcohol, it is often conjoined with other medicines—with ether or ammonia, when more prompt and powerful stimulation is desired; with opium or chloral hydrate, when anodyne effects are required, or spasms are to be combated; with digitalis, when the full effects of a cardiac tonic and stimulant are sought; with ammonium acetate, when diaphoresis is to be encouraged; with red cinchona or coto barks, creasote, or sodium benzoate, when antiseptic and astringent effects are to be produced on the intestine.

ALOES.

Aloe. Inspissated juice from the transversely-cut bases of the leaves of various species of Aloe. *Nat. Ord.*—Liliaceæ.

The several species of **Aloe,** which yield the various commercial aloes, are succulent liliaceous perennials, having short woody stems; strong, thick, fleshy, amplexicaul light-green leaves, with sharp serrated edges, and a stout spine projecting at the apex; while on a slightly branched scape are carried a raceme of yellow, scarlet, or white tubular pendulous

flowers. Underneath the leathery cuticle and exterior to the loose mucilaginous pulp, lie elongated thin walled cells, which contain the yellow, bitter purgative juice. Somewhat different processes are pursued in extracting and concentrating this juice. The better qualities exude spontaneously from the base of the cut leaves. Inferior results are obtained when the leaves are exposed to pressure or heat, which mix the mucilaginous sap of the mass of the leaf with the cathartic juice; while many specimens are deteriorated in the process of concentration by carelessness in separating impurities and exposure to a high temperature.

The Pharmacopœias recognise Barbadoes and Scocotrine aloes, while a Cape variety is sometimes used.

Barbadoes Aloes.—Aloe Barbadensis, sometimes called Curaçoa aloes, is the variety chiefly used in veterinary practice, and the product of the Aloe Vulgaris. It is exported from Barbadoes and most of the West Indian Islands. A dwarf variety is cultivated; the plants are set out six inches from each other in rows, twelve to eighteen inches apart; the leaves, measuring one to two feet in length, are cut off in March or April, in the heat of the day; under good cultivation the plants last for several years. The leaves are chopped off close to the stem, and placed for twelve to twenty hours in tubs with their cut ends down; from the longitudinal vessels the juice trickles out, is collected in casks, and at convenience is concentrated by boiling for four or five hours, sediment and impurities being carefully kept back. When sufficiently concentrated, the juice is poured into gourd shells, and the opening closed by a portion of shell let in, and secured in its place by a piece of coarse cloth nailed over it. The gourds, when filled, usually weigh from 10 to 40 lbs.; and fully 2000 of these, with a quantity of the drug in boxes, are annually exported from Barbadoes alone. The total export exceeds 1000 cwts., most of which comes to Great Britain. The price ranges according to quality, from £4 to £9 per cwt. Barbadoes aloes has a liver-brown colour; a brown, opaque, earthy fracture; a disagreeable bitter, persistent taste, and a strong and disagreeable odour, especially when breathed upon—an odour generally likened to that of the human axilla. It is tough, hard, and

difficult to pulverise; small fragments are translucent, and of an orange-brown hue; its powder is dull olive-yellow, and darker than that of other varieties. It is almost entirely soluble in proof spirit.

Socotrine, also known as East Indian, Bombay, or Zanzibar aloes, is chiefly imported from Bombay and other Indian ports. It is yielded by the leaves of Aloe Perryi and probably other species. It occurs in red-brown pieces of variable size; darkens on exposure to the air; breaks usually with a smooth resinous fracture; thin fragments are transparent and orange-red or orange-brown; the odour, although strong, is somewhat agreeable; the taste very bitter.

Cape Aloes, brought from Cape Town and Natal, is chiefly got from the Aloe ferox, Africana, or spicata, or from hybrids obtained by crossing these and other varieties. The better qualities have a dark-brown or olive-green resinous appearance, a compact structure, a vitreous, conchoidal, dark-green fracture, and a strong and rather disagreeable sour odour. They are very brittle, and easily reduced to a gamboge-yellow powder. Although sold at less than half the price of Barbadoes aloes, the better qualities of Cape are little, if at all, inferior to them or to Socotrine. Mr Joseph Gamgee's experiments shewed that, compared with Barbadoes, they cause equally copious but less watery discharges, while their action was not quite so long kept up.—(*Veterinarian*, April 1856.)

Caballine or Horse Aloes usually consists of the residue left from the purification of more valuable sorts. It is black, vesicular, and bituminous, lacks the compact structure of the better kinds; has a strong and disagreeably fœtid odour; usually contains such impurities as straw, bark, stones, and sand; and should be discarded from veterinary practice.

Properties.—The several varieties have a resinoid appearance, a specific gravity of 1·364, are rather brittle, their external surface is duller and darker than a freshly-made fracture. They have an intensely bitter and persistent taste, and a strong and more or less disagreeable odour, much increased when the specimen is breathed on or heated. When held in the hand for some minutes aloes softens and becomes adhesive. At a low red heat it is partially fused, froths up, chars, and

burns. Exposure to temperatures exceeding 150° Fahr., alters its composition and impairs its purgative property. Moistened with rectified spirit, a thin stratum examined under the miscroscope exhibits numerous crystals. It is almost entirely soluble in boiling water, which, however, deposits, as it cools, from 60 to 80 per cent. of a brown resin. Good specimens are almost entirely soluble in proof spirit. The watery solution, when cold, reddens litmus, is deepened in colour by alkalies, blackened by iron sesquichloride, and yields a yellow-grey precipitate with lead acetate.

Composition.—The Messrs T. & H. Smith of Edinburgh, who have thoroughly investigated the composition of aloes, have isolated from 25 to 30 per cent. of an active yellow, crystalline, neutral bitter principle—**aloin,** which is noticed more in detail at the end of this article; and about the same proportion of an equally active, soluble, uncrystallisable aloin into which the crystallisable form is convertible by heat, much in the same way as uncrystallisable treacle is formed during the careless manufacture of crystallisable cane sugar. A pale-yellow, mobile, mint-flavoued **volatile oil,** of which an ounce only is obtained from 400 lbs. of aloes, imparts its characteristic odour. Besides mineral matters and albumin, aloes further contains about 30 per cent. of a transparent **brown resin,** deposited from watery decoctions as they cool, almost entirely soluble in rectified spirit, occurring in large amount in inferior samples, in which it is formed at the expense of the aloin usually by exposure of the juice during inspissation to high temperatures. This resin possesses little purgative activity.

Actions and Uses.—Aloes is purgative, small doses, insufficient sensibly to increase the action of the bowels, are bitter tonics; applied externally, it is stimulant and desiccant.

General Actions.—Given by the mouth it is dissolved in the gastric fluid, and emulsionised and saponified by the bile and pancreatic juices. Mr Joseph Gamgee, sen., made seven drachms of Cape aloes into a ball with sixty minims of glycerin, rolled it in tissue paper, and gave it to a horse, which, thirty-three minutes later, was killed by dividing the carotid artery. An hour after the ball was found entirely dissolved; the distinct odour of aloes in the stomach and duodenum had not,

however, extended to the large intestines. Aloes **enters the circulation,** communicates its bitterness and purgative properties to the milk and other secretions, and is **excreted** chiefly by the intestinal glandular apparatus, and also in less amount by the kidneys, when it causes diuresis. It is prone to cause hyperæmia of the kidneys, uterus and pelvic organs. While in contact with the intestine it produces both **peristalsis and increased secretion.** It acts notably on the **large intestines,** which explains in part its rather slow effects. It causes copious, but not such fluid discharges as full doses of salines, gamboge, or croton. It is not so irritant as croton, colocynth, elaterium, or podophyllin. Even after repeated doses it is less liable than most other cathartics to lead to constipation. It **increases** the **secretion of bile.** Professor Rutherford introduced aloes into the duodenum of a fasting dog, and found that although only slight purgation ensued, all the bile constitutents were increased. It is said to produce evacuations which possess a peculiar disagreeable odour (Hertwig).

Six drachms of Barbadoes aloes, dissolved in twenty-four ounces of water, and injected into the jugular vein of a horse, caused nausea, frequent straining and efforts to dung, colic—which, however, was only of short duration—and, after twelve hours, purgation. When injected into the veins, it sometimes acts on the kidneys rather than the bowels. Moiroud injected four drachms, dissolved in diluted alcohol, into the veins of a horse, and next day eight drachms, dissolved in a similar manner; but instead of catharsis, observed only diuresis.

The several varieties differ somewhat in the degree of their action: Barbadoes, although the most expensive, is generally preferred by veterinarians. It is the most active and uniform in its effects, nor does it seem to be more drastic than the Socotrine, while it is certainly less liable than the Cape to produce diuresis. Every sort is most effective when freshly powdered; and hence, except for immediate use, should be kept in pieces, preserved from moisture in oiled silk or in tin canisters. A temperature approaching 150° Fahr. applied, whether in the extraction of the juice, or in making it up for use, impairs activity by converting the active aloin into inert resin.

In the horse, a cathartic dose generally causes in a few hours dryness and increased warmth of the mouth; an advance of one or even two degrees in temperature occasionally occurs; the pulse is somewhat quickened; nausea, colic, and copious secretion of urine may result. Such diuresis occurs sometimes with good Barbadoes aloes, especially when the bowels are constipated, and more commonly with inferior specimens of Cape and other kinds, in which the aloin has been converted into resin. Combination with jalap, calomel, or other purgatives, usually counteracts this diuretic tendency. Combination with ginger or other aromatics, or with hyoscyamus or belladonna, wards off nausea and tenesmus. The purgative effect is usually accelerated and increased by giving the drug in solution, or conjoined with oil or calomel.

The time required for the operation of aloes differs considerably in different horses, being modified by various circumstances, especially by the previous feeding. Four to six drachms generally **operate in sixteen to twenty-four hours.** The degree and continuance of the action are also liable to variation; in some horses, purging is over in two or three hours; in others, it extends over twenty-four hours. Where aloes fails to move the bowels, it is seldom wise to prescribe another dose until forty-eight hours have elapsed. A second too-closely-following dose is liable to cause nausea, or superpurgation. Meanwhile, if further physic is believed to be absolutely necessary, oil and a little calomel are preferable to more aloes, and enemata should be diligently used. In order to prevent superpurgation, which even ordinary doses of aloes and other cathartics occasionally produce in horses, it is important, until the physic has set, that the amount of cold water drunk be carefully regulated, and that the animal, although getting a little walking exercise, shall not be put to work. Neglect of such precautions is liable to produce not only superpurgation, but enteritis and laminitis.

In ruminants, aloes is neither a prompt nor a powerful purgative. When given to cattle, even in the fluid state and in doses of several ounces, it fails to produce copious evacuations, such as are obtained in the horse. Hertwig mentions that, in an experiment made at the Veterinary School of Lyons, a cow got six ounces of aloes, partly in solution, partly in

electuary; but, although uneasiness and loss of appetite were observed, the bowels remained unmoved. Gilbert also gave six ounces, with an infusion of four ounces of senna leaves, without effect. Sheep and goats take doses varying from two drachms to an ounce, without being speedily or certainly purged. This tardy and uncertain effect mainly depends on aloes acting particularly on the large intestines, which are not so developed in ruminants as in horses; and on its notable increase of peristalsis, which is difficult to excite in ruminants.

For the dog, aloes, when given alone, is neither so speedy nor so safe a cathartic as calomel and jalap, or castor oil. It has also the disadvantage of occasionally producing irritation of the rectum; but this may, in great part, be overcome by combining it with other purgatives. The dose required to purge a dog is large as compared with that administered either to human patients or to horses. The doses of most medicines for men and dogs are very similar; but man is purged by an eighth or tenth of the aloes requisite to physic the dog. Aloes is a good purge for **swine,** but usually takes about twelve or fifteen hours to operate.

Medicinal Uses.—Aloes is the **purgative in general use for horses.** In dyspepsia, where the appetite is capricious, the bowels irregular, the coat staring, or where there is itching and fulness of the limbs, a dose of aloes is prescribed, generally followed by salines, acids, or bitters. In torpidity of the bowels, it is conjoined with nux vomica, which stimulates peristalsis. In flatulent colic it is rubbed down with hot water, and administered with volatile oils, ethers, ammoniacal or other stimulants. In spasmodic colic, it is also given in fluid form along with a stimulant and anodyne. Professor Dick was wont to recommend four or five drachms of aloes dissolved in a quart of hot water, and given with an ounce each of oil of turpentine and laudanum. Some bad colic cases are relieved by conjoining with the aloes twenty-five to thirty minims of Pharmacopœia tincture of aconite. When the bowels are overloaded with indigestible food, aloes is also frequently given, although linseed oil and calomel are generally preferable; but whatever physic is used, enemata should be thrown into the colon with an extra long tube, in quantities of six or eight gallons (p. 139). Alike

in obstruction, obstinate torpidity, and serious cases of colic, these copious enemata introduced into the large intestine are very important adjuncts. The bitterness and power of increasing peristalsis render aloes useful as a vermifuge. In such cases, it is administered with oil of turpentine, ether, santonin, sometimes with iron or copper sulphates. Although aloes is effectual in sweeping out excess of bile lodged in the intestines, it is unsuitable in jaundice, or torpidity of the liver, in which the bile requisite for its prompt solution and emulsifying is deficient. In such cases, salines, oils, and calomel are preferable, or the aloes may be prescribed with ox bile, which greatly assists its action.

Aloes **purges both the bowels and the blood.** It promotes excretion of waste products, and hence usefully relieves febrile symptoms, rheumatic attacks, skin irritation, swollen limbs, and tender joints. It is effectual alike in preventing and curing lymphangitis ; while it also hastens the removal of œdematous swellings, when not depending upon debility or serious disease of internal organs. Removing excreta, and withdrawing, by a species of derivation or counter-irritation, blood from congested or inflamed parts, it relieves irritation and inflammation of the brain and spinal cord, full doses being usually requisite ; while it is also serviceable in the onset of paralysis, especially in subjects in gross or high condition, or with gastro-intestinal derangement. Repeated doses lessen the formation of superfluous blood and fat, are given both professionally and empirically to promote condition—an object usually, however, more safely and effectually secured by judicious feeding and well-regulated exercise.

Among cattle and sheep, in constipation and indigestion, as well as in febrile and inflammatory complaints, aloes is occasionally given ; but, as already stated, it is less reliable than for horses. If used for ruminants, it should be combined with salines, gamboge, or croton, and given in the fluid form. For **dogs** it is sometimes prescribed in the same class of cases in which it is given to horses ; but calomel and jalap, or some of the oils have the advantage of acting more speedily and surely.

Aloes should be **avoided** in irritation or inflammation of the alimentary canal, and in piles or hæmorrhage from the rectum.

In bronchitis and other inflammatory affections of the mucous membranes or skin, in inflammation of the kidneys, and in influenza and typhoid complaints generally, if used at all, it must be with great caution; for in such cases the intestinal mucous membrane is unusually irritable, and superpurgation and inflammation are readily induced. During pregnancy, both in the mare and bitch, the violent operation of aloes must be carefully avoided. Some practitioners give it both to foals and calves, but for these young animals linseed or castor oil, or a mixture of the two, is more suitable.

As a tonic aloes is occasionally prescribed in enfeebled and relaxed conditions of the alimentary canal, and where there is suspicion of intestinal worms. It is sometimes applied externally, as a gentle stimulant and desiccant, and is an ingredient of the once famous Friars' balsam. (*See* Benzoin.)

Doses, etc.—Horses receive ʒij. to ʒx., the dose depending upon the rapidity and amount of catharsis required. For foals several months old, the dose may be readily ascertained by allowing grs. v. for every week of the patient's age. Cattle take ℥i. to ℥ij.; sheep, ℥ss. to ℥i.; dogs, grains xxx. to ʒiss.; and swine, ʒij. to ʒv.

As a bitter tonic, the dose of aloes for any of the domesticated animals is about an eighth or tenth of that given as a purgative. Tonic doses may be administered twice daily, in combination with other bitters and aromatics. A convenient laxative tonic for the horse is made with two drachms each of aloes, gentian, and ginger, rubbed into a ball with treacle. Another of less laxative effect is prepared with a drachm each of aloes and iron sulphate, and half-an-ounce of ginger, made up with treacle and linseed meal. Either of these may be repeated daily, or every second day.

Aloes is generally administered in the form either of **ball or watery solution.** A ball for immediate use is made with freshly-powdered aloes, mixed with about one-eighth of powdered ginger, and made up with soft soap, lard, glycerin, or vaselin. The physic mass of the Royal (Dick) Veterinary College consists of equal weights of Barbadoes aloes and treacle, with two ounces of ginger to every pound of aloes. The addition of ginger, or some such aromatic, hastens catharsis, and diminishes nausea

and griping. The ingredients are mixed over a slow fire, and constantly stirred until properly melted, great care being taken to prevent the temperature rising above 120° Fahr. The mass should be kept in air-tight jars with closely-fitting covers—the balls being made up as required. Another good and less bulky mass is prepared by adding to melted aloes about one-fourth of its weight of rectified spirit or oil of turpentine, which is retained by the resinous matter, and keeps the mass long soft and moist. Aloetic balls made with lard, oils, or soap, are only suitable for immediate use, and, if kept for several weeks, become dry and hard. Drying may, however, be retarded by adding a little glycerin and an ounce of potassium carbonate or acetate to every pound of the combination. Twenty grains each of powdered aloes, jalap, ginger, and soap, made into a pill, with glycerin or vaselin, is a good purge for a large dog, and will make two doses for a smaller.

Watery infusions are prepared by rubbing down the aloes in hot water, avoiding a temperature exceeding 120° Fahr., and answer well for immediate use. **Tinctures** are made by macerating the drug, in coarse powder, in proof spirit for seven days, and may be of such strength as suits the practitioner's convenience. **Extracts,** made with the view of removing a portion of the resin, have nothing to recommend them. It is slowly dissolved when introduced into the rectum, and hence exerts little laxative effect; but one or two drachms are occasionally ordered as an enema for the horse, dissolved, with soap and a drachm of potassium carbonate, in two quarts of warm water.

ALOIN.—In 1850, Messrs T. & H. Smith, Edinburgh, discovered, first in Barbadoes aloes, and subsequently in the other varieties, the active crystalline principle Aloin ($C_{16} H_{18} O_7$). An analagous crystalline substance has been separated from Natal aloes, and named nataloin, while from Socotrine aloes socaloin has been obtained. These three aloins are generally believed to be isomeric, although some authorities regard them as a homologous series. Histed distinguishes them by the following tests:—A drop of nitric acid produces with barbaloin a brilliant crimson which rapidly fades; with nataloin a brilliant crimson, which is permanent unless heat be applied; with socaloin little effect follows. A drop of sulphuric acid, similarly

applied, and a rod dipped in nitric acid passed over the mixture has no effect on barbaloin or socaloin, but develops with nataloin a fine blue.

Messrs Smith prepare aloin as follows (*Monthly Journal of Medical Science*, Feb. 1851):—Barbadoes aloes is powdered with sand to prevent agglutination, macerated in successive quantities of cold water, and the solutions thus obtained mixed and concentrated *in vacuo* to the consistence of a syrup. This, after being kept in a cool place for two or three days, becomes filled with minute brownish-yellow granular crystals of impure aloin, which is purified by drying between folds of bibulous paper, and by repeated solution in hot water, filtration, and crystallisation. Ultimately it is dissolved in hot rectified spirit, from which the pure aloin crystallises in radiating masses of prisms of a pale yellow colour, breaking when in mass with a dull short fracture. Messrs Smith inform me that the crystals are long, slender, four-sided monoclinic prisms, having the oblique rhombic prism for the primary form. Pure barbaloin is odourless; its taste, at first slightly sweet, soon becomes intensely and permanently bitter, and distinctly aloetic. It is entirely combustible, burning with a yellow flame and much smoke. It yields, by destructive distillation, an aromatic volatile oil, and a resinous residue. It is neutral to test paper; is soluble in rectified spirit, but less so in cold water, an ounce of which dissolves about a grain of aloin. The solvent power both of water and alcohol is greatly increased by heat. Barbaloin is also dissolved by acetic acid and alkalies, forming with the latter orange-yellow solutions, which deepen in colour by oxidation. It is insoluble in ether, oil of turpentine, and chloroform. Watery solutions rapidly darken by exposure to air and light; and, when heated above 150° Fahr., the aloin is oxidised, decomposed, and converted into a resinous substance of little activity.

Actions and Uses.—For twenty-five years aloin has been used with growing favour in medical practice, and with some practitioners it has entirely superseded aloes. The dose for an adult is about one grain, or between a fourth and a third of the quantity of Barbadoes aloes usually prescribed.

Messrs T. & H. Smith having liberally supplied me with

aloin, I administered drachm doses made up with flour and glycerin to six three-parts-bred carriage horses, four and five years old, 15 to 16 hands high, in good health and condition, and prepared with only one bran mash given four hours before the aloin. No effect was observable on the pulse, temperature, appetite, or secretion of urine; the bowels were relaxed to a slight extent in two of the animals, when they were exercised twenty-four hours after receiving their ball; whilst in two of the subjects of experiment fulness and itching about the joints disappeared, although no sensible effect was observed on the bowels. Drachm doses of aloin, conjoined with half an ounce each of gentian and ginger, is serviceable in abating febrile symptoms, and removing heat and fulness of the limbs in hard-worked or grossly fed horses. Two drachms of aloin given to strong five and six year old hunters, well prepared by mashes for upwards of twenty-four hours, caused, in thirteen or fourteen hours, abundant fluid evacuations. Nothing notable was observed as to the pulse or temperature; there was less dulness and loss of appetite than usually accompany the full action of ordinary physic; there was no nausea or griping; the purging usually continued about six or eight hours. In these horses, which were living in the country, it will be noted that two drachms aloin operated several hours earlier, without impairment of appetite or spirits, and with the certainty and effect which usually follow six drachms of Barbadoes aloes.

Mr Thomas A. Dollar, of New Bond Street, London, frequently prescribes aloin, and furnishes the following observations regarding its efficacy:—London horses, he remarks, are generally more susceptible to the action of physic than country patients. Five carriage horses, $15\frac{1}{2}$ to 16 hands high, prepared by mashes during two days, received two drachm doses of aloin, made up with ginger and treacle, and were purged with less dulness, nausea, and griping than attend the administration of full doses of aloes. In several cases the purging came on within twelve hours; full and fluid evacuations occurred; but there was less prostration and interference with appetite than usually attend the action of physic, and the horses were ready to return to work a day sooner. Three heavy cart horses received two and a-half drachms aloin, made up with ginger and

treacle, and in eighteen hours were as fully physicked as if they had got six drachms of good Barbadoes aloes. As in the better-bred animals, dulness, nausea, loss of appetite, tenesmus, and diuresis were looked for in vain. From these and other observations, Mr Dollar concludes that, comparing aloin with the crude drug, a little less than half the quantity acts in horses with more certainty and equal effect.

On a strong shorthorn cow two drachms, dissolved in hot water, and given with an ounce of ginger, exerted only a mildly laxative effect; but three drachms operated tolerably freely in twenty hours. Two drachms, with half a pound Epsom salt, acted as rapidly and effectually as $1\frac{1}{4}$ lb. Epsom salt. English terriers, 20 lbs. weight, are little affected by doses of 20 grains given in bolus; even drachm doses had scarcely any effect on pointers and setters; but when two or three grains of calomel or half a drachm of jalap are added, full effects occur in six or eight hours.

Old and knowing horses, familiar with the smell of aloes, and induced to swallow it with difficulty, show much less antipathy to the inodorous aloin. Definite and uniform in composition, more concentrated in form, and now offered by the discoverers, Messrs T. & H. Smith, at a reduced rate, which renders it scarcely more expensive than the best qualities of the crude drug, aloin should come into more general use as a cathartic for horses.

ALUMINIUM AND ITS MEDICINAL COMPOUNDS.

POTASH ALUM. ALUMEN. Aluminium and Potassium Sulphate, $Al\,K\,(SO_4)_2.\ 12\ Aq.$

SODA ALUM. $Al\,Na\,(SO_4)_2.\ 12\ Aq.$

AMMONIA ALUM. $Al\,NH_4\,(SO_4)_2.\ 12\ Aq.$

ALUMINA. $Al_2\,O_3.$

The alums are a series of double salts in which aluminium sulphate is conjoined with potassium sodium or ammonium sulphate. They are found in limited quantity on the surface of soils and rocks, especially in volcanic districts; and are

largely prepared from aluminous clay, shale, or schist, which mainly consists of aluminium silicate and iron sulphide. Near Paisley, where alum is extensively manufactured, the schist lies between the coal and limestone strata. When slowly roasted it absorbs oxygen, and the sulphur is converted into sulphuric acid, which unites with the iron and aluminium. Water is added, and a large portion of the less soluble iron sulphate crystalises out.

To make **potash alum** this residual solution is treated with potassium chloride, usually obtained as a biproduct from the soap-boilers, saltpetre refineries, and glass houses; double decomposition results. The remaining iron sulphate is converted into iron chloride, which continues in solution; while potassium sulphate unites with aluminium sulphate to form potash alum, which crystallises, and is further purified by repeated solution and crystallisation. In the north of England the clay schist is calcined, placed in iron chambers, and sulphuric acid poured over it; a temperature of 140° F. is kept up by steam, and ammonia vapour blown into the chambers, as well as by fire underneath. The solution is drawn off into coolers, agitated to prevent formation of large crystals, and the alum flour washed and re-dissolved by steam. To prepare **soda alum,** sodium chloride, instead of potassium chloride, is added to the dissolved iron and aluminium sulphate extracted from the roasted clay. To produce the corresponding **ammonia alum,** which, on account of its cheapness, has generally superseded the other alums in dyeing, calico-printing, and paper-making, as well as in medicine, ammonia sulphate, the refuse of the gas-works, is added to the roasted lixiviated shale.

PROPERTIES.—The alums occur in transparent, colourless, cubes or octahedral crystals, have a sweet, acidulous, astringent taste, act like acids on colouring matter, and, when heated, fuse and part with their twelve molecules of water of crystallisation. They are soluble in one third of their own weight of water at 212° F., and in seven parts of cold water. Like other aluminium salts, they are distinguished by negative action with hydrogen sulphide; and by white precipitates of aluminium hydrate thrown down by ammonium sulphide, and by caustic potash or soda, but soluble in excess. Moistened with

cobalt solution, and heated in the blowpipe flame, alum salts develop a blue colour.

Alums are apt to be contaminated by iron, discoverable by the yellow colour it imparts to the crystals, and by the blue precipitate it gives with solution of yellow prussiate of potassium. But iron, though rendering alum unfit for dyeing, does not interfere with its medicinal properties.

Alumina ($Al_2 O_3$), obtained by burning ammonia alum, or treating an alum solution with excess of ammonia, has neither colour, smell, nor taste, but it exhibits great affinity for water, attracts from the atmosphere one-third of its own weight of moisture, has a strong affinity for colouring matters, and hence is much used in dyeing and calico-printing. Conjoined with silica it constitutes **clay,** which, on account of its plasticity and slight fusibility, is employed for making the many varieties of pottery and porcelain. Alumina in crystalline form, coloured with traces of chrome or iron oxides, constitutes the ruby and sapphire. Corundum and emery are impure alumina.

Actions and Uses.—Alum is slightly irritant and astringent, and is chiefly used externally as an astringent styptic and desiccant.

Toxic Effects.—One or two ounces given to dogs cause vomiting. But when the œsophagus was tied, and vomiting prevented, Orfila found that two ounces occasioned death in five hours, with great exhaustion; the intestines were found extensively inflamed. Devergie (quoted by Pereira) found that four drachms of burnt alum killed a dog when the gullet was tied. An ounce introduced into the areolar tissue of a dog's thigh caused excessive suppuration, and death in fifteen hours. Moiroud says that large doses given for some time continuously exhaust the digestive organs, diminish cutaneous transpiration, and produce grave disorders. Bourgelât states that it causes chronic lung irritation in horses. Several ounces are occasionally given to cows to arrest the lacteal secretion, and, although continued for several weeks, do not produce any obvious bad effects. Alum is decomposed in its passage through the intestines, rendering the fæces firmer and odourless. Overdoses are decomposed and rendered inert by

small and repeated doses of sodium carbonate, followed by demulcents.

Medicinal Uses.—The alums closely resemble the copper and zinc salts, but are not so active. They are occasionally given to the dog as **emetics.** Applied in a dry state they absorb water from the soft tissues, and hence act as **mild caustics.** They have little effect upon the unbroken skin. They coagulate albumin and gelatin, and hence invest the abraded skin and mucous membranes with a protective film, constrict them and diminish their blood supply, thus relieving congestion and lessening secretion. In virtue of these **astringent** properties, they are used as lotions for aphthous ulcerated conditions of the mouth; as gargles and spray for sore throat; as soothing **healing dressings** for blistered surfaces; as injections for leucorrhœa; and in all such cases are frequently conjoined with borax. They are occasionally prescribed along with opium in diarrhœa and dysentery. They were formerly given in polyuria in horses, but iodine and iron salts are greatly more effectual. In powder, mixed with two or three parts of wheat flour, they are sometimes applied to **arrest bleeding** and flow of **synovia** from open bursæ or joints. They have been recommended for the purification of drinking water.

Doses, etc.—As an astringent, horses and cattle, ʒij. to ʒiv.; sheep and pigs, grs. xx. to ʒij.; dogs, grs. x. to grs. xx.; given either in bolus or solution. **Externally** there are used powdered alum or alum flour, a watery solution, and an ointment made with one part of alum to three or four of lard or vaselin. The burnt or dried alum of the B. P. is little used. Alums are incompatible with alkalies and their carbonates, with lime salts, phosphates, salts of lead and mercury, and tannin-containing bodies.

Pipeclay and **fullers' earth,** both aluminium silicates, are useful desiccants and mild astringents, much used for wrung shoulders, harness galls, and simple wounds. **Aluminium sulphate** ($Al_2\,3SO_4.18$ Aq.) is occasionally used as a mild caustic, antiseptic, and astringent

ALUMINIUM CHLORIDE. CHLORIDE OF ALUMINIUM. CHLORALUM. ($Al_2 Cl_6$).

When a mixture of alumina and charcoal is heated in a current of chlorine gas, the white volatile aluminium chloride is produced. When aluminium sulphate and calcium chloride are dissolved together, double decomposition ensues, and there remains in solution an impure hydrated aluminium chloride—a colourless oily fluid, with a sweet astringent taste, sold as chloralum.

ACTIONS AND USES.—Like many metallic chlorides, chloralum is corrosive, astringent, and antiseptic. It has been recommended in influenza, typhoid complaints, and farcy in horses, in dysentery in cattle, and in distemper in dogs. Drachm **doses** suffice for horses or cattle, grains v. to grains x. for dogs. It may be used either in bolus made with meal, or dissolved in water or gruel. **Externally** it may be applied for the several astringent purposes for which alum or zinc sulphate are serviceable. As an antiseptic it has been more used on the Continent than in this country. Dr Angus Smith, in his experiments undertaken for the Cattle Plague Commissioners, found that for the preservation of night-soil, chloralum proved inferior to common salt, carbolic acid, and zinc and iron chlorides. As a deodoriser it proved more effectual than alum, but less effectual than tar oils, sodium sulphite, or bleaching powder. Unlike such volatile bodies as carbolic or sulphurous acids, it does not diffuse through the air and attack floating contagious germs. Diluted solutions destroy the parasites of mange and scab, and kill fleas and ticks.

AMMONIUM AND ITS MEDICINAL COMPOUNDS.

AMMONIUM HYDRATE. AMMONIA. Caustic Ammonia. Hartshorn. Spirit of Hartshorn. Liquor or Aqua Ammoniæ. Gaseous Ammonia (NH_3) dissolved in water.

Traces of ammonia exist in the air, and in rain. It occurs in the excretions of living animals, from the breaking down of their nitrogenous tissues; and is evolved from the putrefaction and destructive distillation alike of vegetable and animal

matters. It appears to be formed directly from the nitrogen of the air by the growth of fungi. But the coal beds are the great commercial source of ammonia and its compounds. The waste liquor of the gasworks treated with hydrochloric acid yields ammonium chloride or sal-ammoniac.

Three parts coarsely powdered sal-ammoniac are mixed with four of dry slaked lime, the mixture transferred to large retorts, and gradually increasing heat applied, when ammonia gas is evolved, and conducted into receivers containing water, one volume of which at 60° Fahr. absorbs upwards of 700 volumes of the colourless, light, irritant, irrespirable, gaseous ammonia (NH_3). Exposed to a temperature of $-40°$ Fahr. gaseous ammonia condenses into a clear liquid, which, at $-103°$ Fahr., becomes a white crystalline solid. This ready volatility and liquefaction is taken advantage of in Carré's freezing apparatus, in which a concentrated solution of ammonia is heated in a strong boiler, passes along a pipe into a hollow receiver, where it liquefies by its own pressure. When the boiler is removed from the fire, and cooled in water, the liquid ammonia volatilises, rushes back to the boiler, abstracting so much heat that water placed in the cavity of the receiver is congealed. The volatile gaseous ammonia passing back to the boiler, the process is repeated indefinitely. This system of ice-making is now extensively adopted for cooling meat in summer, for the preservation of fresh meat in transit from America and Australia, and for the summer manufacture of beer.

Properties.—**The liquor ammoniæ fortior** is colourless, pungent, and caustic, and consists of 32·5 per cent. of gaseous ammonia dissolved in water. Its specific gravity is 0·891; 52·3 grains by weight require for neutralisation 1000 grain measures of the volumetric solution of oxalic acid. One fluid drachm contains 15·83 grains of gaseous ammonia. Purity is insured when the sample, diluted with four times its volume of distilled water, gives no precipitate with solution of lime, ammonium sulphide, or copper ammonio-sulphate, and, when treated with an excess of nitric acid, it is not rendered turbid by silver nitrate or barium chloride (*B.P.*). It has strong alkaline reactions, and unites with fats and oils, forming soaps and liniments.

Ammonium salts are not acted upon by many reagents, but are distinguished by their volatility and odour.

For most medicinal and pharmaceutical purposes the liquor ammoniæ fortior is too concentrated, and a diluted solution is made by adding to the fortior two measures of distilled water. This medicinal solution is entitled **liquor ammoniæ,** contains 10 per cent. by weight of gaseous ammonia, and has the spec. grav. ·959.

A **spirit of ammonia** of corresponding strength, containing 10 per cent. of gas in rectified spirit, is recognised by the U.S.P.

Aromatic spirit of ammonia, popularly known as sal-volatile, is a solution of ammonia fortior and ammonium carbonate in rectified spirit and water, usually flavoured with oils of nutmeg and lemon.

General Actions and Uses of Ammonium Salts.—They resemble potassium and sodium salts, but being more volatile, are more prompt and powerful. Unlike caustic potash and soda, ammonium hydrate does not dissolve the epidermis, and hence does not cauterise, but, if evaporation be prevented, it passes through the epidermis, irritates the dermis, and **vesicates.** Dr Lauder Brunton thus describes the several actions of ammonium salts:—"Ammonium is considerably modified by the acid radicle with which it is combined. All the ammonium salts have an action on the spinal cord, motor nerves, and muscles, and, in advanced poisoning, paralyse these structures. . . . They appear to form a series, at one end of which the members stimulate the spinal cord, and have no marked paralysing action on the motor nerves; while those at the other end have no marked stimulating action on the cord, but, on the contrary, have a marked paralysing action both on the cord and on motor nerves. At the stimulating end of this series are ammonia and ammonium chloride, and at the paralysing end ammonium iodide; whilst the bromide phosphate and sulphate lie between."—(*Pharmacology, Therapeutics, and Materia Medica.*) In their primary stimulation and secondary paresis, ammonium salts resemble the mono-hydric alcohols and ethers; but they act more markedly on the cord and motor centres, and less on the higher cerebral centres. Their antidotes are dilute acids, milk, and oils. Ammonium salts increase the secretion of the bronchial and intestinal glands, and also of the sweat glands and kidneys. In the blood of mammals ammonia is converted

almost entirely into urea, in the blood of birds into uric acid. It increases the formation of glycogen in the liver, and of acidity in the urine. (*Brunton.*)

Actions and Uses of Ammonia.—The ammonia solutions stimulate the spinal cord, motor nerves, and muscles, cause tetanus, subsequently paralyse the cord, but, unlike ammonium chloride, do not markedly paralyse motor nerves. Ammonia vapour entering the air passages causes suffocation. Strong solutions swallowed, produce gastro-enteritis, while, from absorption, paralysis of the brain centres and coma occasionally ensue. Reflexly, when applied to the nostrils or stomach, it stimulates circulation, and, after absorption, directly stimulates the circulatory and respiratory nerve centres. It is administered as an antacid, diffusible stimulant and antispasmodic, and used externally as a stimulant and counter-irritant.

Toxic Effects.—Hertwig found that half an ounce of the strong solution, given diluted, had no bad effects on horses, but that one ounce proved fatal in sixteen hours, and three ounces in fifty minutes; the latter quantity causing violent cramps and difficult breathing. Half a drachm introduced into the stomach, and retained by tying the œsophagus, destroyed a dog in twenty-four hours, causing much uneasiness, agitation, and stupor, and leaving after death slight redness of the villous coat of the stomach (*Orfila*). The most effectual antidotes are vinegar, and other diluted acids, with diluents and demulcents.

Medicinal Actions.—Its **antacid and stimulant** properties recommend ammonia in indigestion, tympanitis, and spasmodic colic. Stimulating vaso-motor and respiratory centres, it is a diffusible stimulant, valuable in antagonising syncope or apnœa in influenza and other typhoid complaints. As in human practice, ammonia fumes are occasionally used to rouse animals from faint, shock, or narcotic poisoning, but must be used cautiously, lest excessive irritation of the respiratory mucous membrane be produced. It is a promptly-acting **antidote** in poisoning by opium, aconite, digitalis, and other narcotic and sedative drugs. It is administered in the usual way, injected intravenously, and also applied externally in the treatment of snake bites; but its success is uncertain, especially in the case of the cobra and other venomous snakes. On account of its

promoting bronchial secretion, and assisting in its expulsion, ammonia is serviceable as a **stimulating expectorant** (p. 58). To develop its more general effects, it is frequently prescribed with alcoholic stimulants, as in the convenient forms of the spirit and aromatic spirit.

EXTERNAL USES.—Owing to its rapid evaporation, ammonia has not much rubefacient effect, unless it is smartly rubbed in, when it proves a useful **counter-irritant** for rheumatic muscles or joints, for sore throat and bronchitis; for maintaining the stimulation produced by mustard or cantharides; for influenza, purpura, and scarlatina cases, where the more irritant mustard and cantharides are unsuitable; and for preventing the chilling of fomented surfaces. If a pledget of lint saturated with ammonia be applied to the skin, and evaporation prevented by covering with a piece of oiled silk, the ammonia penetrates the epidermis, and quickly **vesicates.** It neutralises the acid virus, and relieves the irritation caused by stings of nettles, wasps and other insects, and by bites of some snakes.

DOSES, ETC.—Of the liquor ammoniæ fortior as a diffusible stimulant and antispasmodic, horses take f℥ to f℥ij.; cattle, f℥ij. to f℥vi.; sheep and pigs, f℥j.; and dogs, ♏v. to ♏x. The liquor ammoniæ, the spirit, and aromatic spirit being about half the strength, are given in double these doses. In order to sustain their transient effects they require to be repeated at intervals of two or three hours. On account of their pungency, they must be largely diluted with water, or, better still, with cold gruel or mucilage. A useful stimulant draught, either for horses or cattle, is made with half an ounce each of liquor ammoniæ, sweet spirit of nitre, and tincture of gentian, given in a quart of ale or of cold gruel. For colic and indigestion in horses, Mr Greaves, of Manchester, recommends a draught composed of half an ounce of medicinal ammonia, with four or five drachms of aloes, given in water. For **external** application the liquor fortior is generally used, mixed with four to six parts of oil. A convenient stimulating **liniment** is made with one part each of ammoniæ fortior, oil of turpentine, and water, mixed with four to six parts of linseed oil. A drachm of ammoniæ fortior, with half-a-pint of soap liniment, makes a useful stimulant embrocation for sore throat.

AMMONIUM CARBONATE. Carbonate of Ammonia. Ammoniæ Sesquicarbonas. Hartshorn Salt. Smelling Salts.

Professor Rose of Berlin has described twelve ammonium carbonates. The commercial and Pharmacopœia carbonate is prepared by heating about one part of either ammonium chloride or of sulphate with two parts of chalk. It is believed to be a compound of acid ammonium carbonate (NH_4. HCO_3), with ammonium carbamate (NH_4. NH_2. CO_2), and the B. P. gives the formula, N_3H_{11}. C_2O_5.

It occurs in colourless, translucent, fibrous, crystalline, concavo-convex cakes, the shape of the receivers in which it is condensed. It has a pungent alkaline taste, and a strong ammoniacal odour; is soluble in four parts of cold water and rather less of tepid water; dissolves sparingly in alcohol; decomposes in boiling water, with evolution of ammonia and carbonic acid; sublimes when heated; and when exposed to the air becomes opaque, friable, and covered with a white powder of bicarbonate. It is little liable to adulteration.

ACTIONS AND USES.—The carbonate closely resembles ammonia hydrate, but is less volatile, less powerful, and rather more permanent in its effects. Large doses produce, however, the same primary stimulation, and secondary paralysis of the spinal cord and motor centres. Orfila records that two and a-half drachms given to a dog caused gastric inflammation, tetanic convulsions, and death.

MEDICINAL USES.—It is given to all animals in atonic dyspepsia; conjoins the actions of an **antacid and diffusible stimulant**; in small doses promotes secretion of gastric juice, and in larger relieves flatulence and spasm. A few doses materially help the extra rug, warm bran mash, and other hygienic remedies in combating chill, blowing, and other premonitory symptoms of disease of the air passages in hard-worked horses. It **stimulates** both **cardiac** and **respiratory functions,** and hence is prescribed in influenza, scarlatina, and other typhoid cases, and in the later stages of various acute debilitating inflammatory complaints, in many such patients being substituted for or conjoined with alcoholic stimulants. It **promotes bronchial secretion** and **expectoration,** and hence relieves

bronchial congestion, being especially serviceable where the lower bronchi are choked with mucus, and cardiac action is weak. It is sometimes given to **dogs** as a **stimulant emetic,** either alone or in conjunction with ipecacuanha, or other such emetic; and, in respiratory diseases, while sustaining the action of the heart, it clears away excessive bronchial secretion, and relieves congestion. It sometimes averts epileptic fits in weakly dogs. It neutralises the poison of wasps' stings and insects' bites.

Doses, etc.—Horses take ʒij. to ʒiv.; cattle, ʒiij. to ʒvj.; sheep and pigs, grs. xv. to grs. lx.; dogs, grs. iij. to grs. viij. It is given either in bolus with linseed meal, or dissolved in gruel, which, to prevent volatilising of the ammonia, must be used cold. Where prompt stimulant and restorative effects are required, ammonium carbonate is conjoined with alcohol, ether, or sweet spirit of nitre; where febrifuge and expectorant effects are sought in diseases of the respiratory organs, it is prescribed with potassium chlorate and camphor; while in chronic gastric derangements, it is given with gentian, ginger, or cinchona bark. Smelling salts are prepared by adding to the carbonate half its weight of ammonia fortior, and mixing some bergamot, lavender, or other aromatic oil.

Ammonium Chloride. Sal-ammoniac. Chloride of Ammonium. Muriate or Hydrochlorate of Ammonia. (NH_4 Cl.)

This salt, from which most ammonium compounds are procured, is chiefly prepared from the ammoniacal liquor of the gas-works, by treating it with diluted hydrochloric acid, or in some manufactories with common salt or impure calcium chloride. The solution, when slowly evaporated, yields brown crystals of chloride, which are purified by sublimation. The salt thus prepared occurs in colourless, translucent, tough, and fibrous masses. It is devoid of odour, has a saline acid taste a slightly acid reaction on colouring matter; is soluble in about one part of boiling, and three of temperate, water. During solution it abstracts much heat, and is consequently an ingredient of many freezing mixtures. When heated, it sublimes unchanged. Mixed with lime or potash it evolves ammonia.

Actions and Uses.—Large doses exhibit the stimulant and subsequent paralysing effects of ammonium salts. Two

ounces given to a horse caused muco-enteritis (*Moiroud*); two drachms destroyed a small dog in an hour. The alimentary mucous membrane was found congested and swollen (*Orfila*). The symptoms described as occurring in dogs are "muscular weakness, slow breathing, violent action of the heart, and tetanic spasms" (*Christison on Poisons*). The same symptoms and postmortem appearances result when the salt is applied to wounds.

Medicinal doses are believed to stimulate the alimentary and respiratory mucous membranes, promote their secretions, and relieve gastric as well as bronchial catarrh, especially in patients where pyrexia has not been serious or has abated. They are also recommended in torpidity of the liver and rheumatism. The **doses** are the same as those of the carbonate.

It is an occasional constituent of stimulant gargles. Dissolved in water or spirit, it is used as a **refrigerant** lotion for inflammatory swellings, bruises, and sprains. A cooling mixture, which is stated to lower the thermometer from 50° to 10° Fahr. (*Pereira*), is made with four ounces each of sal-ammoniac and nitre, dissolved in eight ounces of water, but for ordinary refrigerant purposes six or eight times this amount of water may be used.

LIQUOR AMMONII ACETATIS FORTIOR. Strong solution of Ammonium Acetate ($N'H_4.\ C_2\ H_3\ O_2$).

LIQUOR AMMONII ACETATIS. Solution of Ammonium Acetate. Mindererus Spirit.

Ammonium carbonates, when gradually treated with acetic acid until a neutral liquid is produced, and diluted with a definite proportion of water, produce the **liquor ammonii acetatis fortior,** which has the spec. grav. 1·073. This liquor fortior, further diluted with five parts of water forms the **liquor ammonii acetatis.** This weaker solution is clear, colourless, and nearly odourless, but has a mawkish, unpleasant taste. Its spec. grav. is 1·022. It is distinguished by the ammoniacal odour developed by admixture of caustic potash, and the acetous odour produced when treated with sulphuric acid.

Actions and Uses.—Ammonium acetate resembles the other ammonium salts. Although not so powerful a stimulant as the liquor ammoniæ or carbonate, it is a valuable **diaphoretic, diuretic, antipyretic, and expectorant.** It is much used in febrile and inflammatory attacks especially affecting the respiratory organs—in catarrh, bronchitis, and pneumonia, in influenza, strangles, purpura, scarlatina, and erysipelas. In these and other such cases it abates fever, promotes skin and bronchial secretion, and helps to clean the tongue and improve the appetite in typhoid cases. In the outset of local inflammations in horses, when pyrexia is considerable, two to four ounces of the liquor ammoniæ or medicinal solution are given, with a drachm of potassium nitrate or chlorate three or four times daily. When the bowels are confined and the urine high coloured, two or three ounces of Epsom salt are added to the febrifuge mixture. When bronchial secretion is scanty the acetate is conjoined with ipecacuanha or potassium iodide, and its good effects furthered by inhalation of moist warm air and by hot applications externally. When the smaller bronchial tubes are choked with mucus, belladonna, balsams, turpentine and squills are useful additions, along with moderate external stimulation. When there is sore throat and cough, belladonna extract and camphor are serviceable adjuncts. In many forms of troublesome cough opium is appropriate. In convalescence, when the appetite is indifferent, powdered gentian or cinchona bark are combined or alternated with the acetate and salines. When the patient is weak and exhausted, alcohol, sweet spirit of nitre or ether are fitting additions. In cerebro-spinal fever the late Professor Robertson prescribed iodine and strychnine with the ammonia acetate.

For cattle similar prescriptions are suitable, given usually in somewhat larger doses. **In dogs** the diuretic effect of ammonium acetate is more notable than the diaphoretic action. A convenient antipyretic and expectorant is made with liquor ammonii acetatis fortior f℥iv.; spiritus ætheris nitrosi f℥ij.; spiritus camphorae f℥i. For large dogs the dose is half a fluid ounce; for small a fluid drachm given diluted with five or six parts of water. This mixture is adapted for special cases by such additions as are above indicated for horses.

Doses, etc.—For horses and cattle the dose of the liquor ammonii acetatis is f℥ij, to f℥iv.; for dogs, fʒij. to fʒiv. given in five or six parts of water, diluted spirit, or linseed tea. Many horses and cattle readily take it in their drinking water. Like the chloride, the solution of the acetate is sometimes used **externally** as a refrigerant discutient.

AMYL-NITRITE.

Amyl-Nitris. Nitrate of Amyl $C_5H_{11}.\ NO_2$.

Amyl-nitrite is prepared by passing nitrous acid (N_2O_3) into amyl-alcohol ($C_5H_{11}.\ OH$) (p. 189.) It bears to amyl-alcohol the same relation that nitrous ether does to ethyl-alcohol. It is a yellow ethereal limpid volatile liquid, with a pine-apple flavour, the spec. grav. ·880; it is insoluble in water, but soluble in rectified spirit, ether and chloroform, and is itself a solvent for oils. It speedily undergoes decomposition; must be kept in well stoppered bottles in a cool dark place; a few weeks' keeping greatly reduces its activity.

Actions and Uses.—It paralyses the motor tract of the spinal cord and the peripheral endings of motor nerves. It relaxes spasm of involuntary mnscles, and dilates arterioles. It consequently lowers blood-pressure, and relieves vascular spasm.

General Actions.—Whether swallowed or inhaled it quickly **converts** the **hæmoglobin** of the blood into **methæmoglobin,** which does not readily part with oxygen; internal respiration is accordingly interfered with; convulsions and asphyxia ensue; both arterial and venous blood aquire a chocolate hue. **Toxic doses** paralyse the spinal cord and motor nerves, reflex action is diminished, voluntary muscles, however, are not paralysed, nor is sensation or consciousness materially affected. **The arterioles** are rapidly and greatly **relaxated and dilated,** depending either on paresis of their muscular walls, or of their vaso-motor ganglia, or on both these conditions. Secretion of perspiration and urine is increased, and the urine contains sugar. Human patients receiving one to two minims within a few minutes are flushed, perspiration overspreads the head and neck, extending sometimes over the

body; there is general vascular dilatation, arterial pressure is reduced, the pulse becomes soft and quickened, breathing is accelerated and sometimes panting. Similar symptoms are produced in dogs, in which temperature is besides lowered 3° or 4°. The **antidotes** are stimulants, alternate hot and cold douches, and artificial respiration.

MEDICINAL USES.—The curative value of amyl-nitrite depends upon its paresis of vaso-motor centres, and of the muscular walls of blood vessels, with consequent relaxation and dilatation of arterioles, and greatly lowered blood-pressure. It has been successfully used by Professor Williams in angina pectoris in horses, and by other practitioners in spasmodic breathing occasionally occurring as a sequel of sore throat and bronchitis. In such asthmatic cases in horses and also in dogs it was used by the late Professor Robertson. Experiments on rabbits made artificially epileptic have shown that it not only prevents the impending fit, but cuts it short when it has begun. It hence deserves more extended trial in epilepsy in dogs and young cattle. Dr B. W. Richardson found that rabbits and frogs which received lethal doses of strychnine had the tetanic spasms relieved, and recovery generally ensured, by prompt administration of amyl-nitrite.

DOSES, ETC.—Horses and cattle take ♏ iij. to ♏ x., dogs ♏ $\frac{1}{2}$ to ♏ ij. A minimum dose should first be tried. When given hypodermically half doses generally suffice. Repeated use does not interfere with its efficacy. It is inhaled or administered on a piece of sugar, or in draught with rectified spirit or ether. Ether, chloral, or full doses of alcohol intensify its effects. The drug must be freshly prepared; when kept even for a few days, depreciation occurs from evaporation, decomposition of the etherous principle, or conversion of nitrite into nitrate.

NITROGLYCERIN or glonoin $C_3H_5\ (NO_3)_3$ is prepared by dropping pure glycerin into a mixture of sulphuric and nitric acids kept cool by ice, and washing it in water. It is a colourless, transparent explosive liquid, soluble in absolute alcohol ether and oils.

Its **actions** resemble those of amyl-nitrite and nitrites, but are more persistent. In dogs and other animals it paralyses

the spinal cord, accelerates the pulse and breathing, and kills by respiratory arrest. It diminishes the oxidising power of the blood, and lessens blood-pressure. Although itself a nitrate and absorbed as such, it is in part decomposed by the alkali of the blood, and reduced to the condition of a nitrite. Like other nitrites it is a muscular poison. *(Dr Lauder Brunton).*

It **is used** for the same purposes as amyl-nitrite. A one per cent. solution in alcohol is the preparation generally prescribed. The dose for human patients is ♏ i. and may be gradually increased. For dogs 20 lbs. weight, suffering from spasmodic asthma or epilepsy, ♏ $\frac{1}{4}$ suffices to begin with.

ANISE.

ANISI FRUCTUS. Aniseed. The dried fruit of Pimpinella Anisum. *Nat. Order.*—Umbelliferæ.

OLEUM ANISI. Oil of Anise. The oil distilled in Europe from anise fruit, or in China from Star-anise fruit, B.P.

The natural order Umbelliferæ yields many aromatic, carminative fruits, such as anise, caraway, coriander, and fennel, as well as the aromatic gum-resins, asafœtida, galbanum, and ammoniacum.

Anise is chiefly imported from Spain, Germany, and Southern Russia. It is an ovoid oblong grey-brown fruit, one-fifth of an inch in length, and covered with minute hairs. Like other fruits of this order, it is separable into two symmetrical mericarps, each of which is encircled by five slender ridges, while its transverse section exhibits about fifteen vittæ, which elaborate the oil. This oil is also prepared from the dried fruit of the Star-anise—the Illicium anisatum, belonging to the *Nat. Ord.* Mangoliaceæ, and grown in China.

Both anise fruits yield about five per cent. of a mixture, in nearly equal proportion, of a fixed oil, and a volatile anethol or camphor-like body, common to the Umbelliferæ, and some other plants, and having the formula $C_{10}H_{12}O$. It is believed to be a phenol derivative, with some of its hydrogen atoms displaced by methyl and allyl, and having the rational formula

$C_6H_4.\ C_3H_5.\ OCH_3$. It is colourless but becomes yellow on keeping; exhibits intensely the characteristic odour and taste of the fruit; and is soluble in alcohol and ether. The oil from the pimpinella solidifies at from 50° to 60° Fahr.; that from the star-anise at about 36° Fahr.

Actions and Uses.—Anise is an aromatic stimulant, stomachic, and carminative. It is used to relieve indigestion and flatulence, to communicate an agreeable flavour to many medicines, and to diminish the nauseating and griping of purgatives.

Doses, etc.—Horses receive about ℥i.; cattle, ℥i. to ℥ij.; sheep and swine, ʒij. to ʒiij.; dogs, grs. xx. to grs. l.; given powdered; repeated several times a day; often conjoined with ginger or other aromatics; and conveniently administered in ale or in spirit and water. **Oil of anise,** like oils of caraway, coriander, cumin, and other Umbelliferæ is a diffusible stimulant, antiseptic, carminative, and antispasmodic. For such purposes cheaper remedies are generally, however, employed; but it is occasionally used as a flavouring ingredient, especially for ball masses, and mixed with a little spirit and bland oil, for the destruction of lice in pet dogs and other small animals.

Caraway, cardamoms, coriander, fennel, and fenugreek, resemble anise in their actions and uses, and may be given in similar doses. They also contain aromatic antiseptic, stimulating, essential oils. These seeds are sometimes used by feeders of pigs, sheep, and cattle, and by wagoners and others, for improving the coat and condition of their charges. Fenugreek especially is prized for such purposes, is a constituent of various "drinks," and, with ground peas, locust bean, and linseed cake, forms several vaunted "nourishing foods."

ANTIMONY AND ITS MEDICINAL SALTS.

The salts and preparations of antimony in their physiological, as well as their chemical relations, **resemble** those of **arsenic and bismuth.** They combine with albumin, are precipitated by acid solutions, and consequently exert their irritant effects on those parts where they are acted upon by acid secretions, as

in the stomach and around the orifices of the sweat glands. With the exception of the chloride, which is a powerful escharotic, antimony salts, locally applied, produce inflammation of isolated spots, causing first papules, and subsequently pustules. The activity of the several preparations differ mainly according to their solubility. Tartar emetic is almost the only antimonial used internally. In animals that vomit they cause emesis, cardiac and vascular depression, and increased secretion. Large doses produce gastro-enteritis, and paresis of the spinal cord. Given for a considerable period they induce fatty degeneration. The geese in the Duchy of Brunswick, fed for their fatty livers, receive daily doses of antimony oxide.

Antimony Oxides. Oxides of Antimony.

The medicinal sesqui- or ter-oxide, also known as native white or flowers of antimony ($Sb_2 O_3$), is often used in painting instead of white lead. It is prepared by direction of the B. P. by decomposing the chloride with water, and carefully washing the precipitated basic chloride with water and a solution of an alkaline carbonate, and drying. It is a greyish-white, tasteless, heavy, crystalline powder, insoluble in water, but soluble in hydrochloric, tartaric, and acetic acids, and forms by oxidation with nitric acid, antimony tetroxide ($Sb_2 O_4$), and antimony pentoxide ($Sb_2 O_5$). The B. P. imitation of the patent James' Powder is made by mixing thoroughly one part of antimony sesquioxide and two parts of calcium phosphate.

Actions and Uses.—Antimony sesquioxide is chiefly important on account of its employment in the preparation of tartar emetic, which it closely resembles in its actions and uses.

Antimony Sulphides. Sulphurets of Antimony. Antimonium Sulphuratum.

The sulphide or stibnite ($Sb_2 S_3$), the most abundant ore of antimony, when purified by fusion, occurs in dark-grey, metallic, heavy, brittle cakes, or as a heavy, grey-black, crystalline powder, devoid of odour and taste, insoluble in water, and known as black or crude antimony. The orange-red sulphurated antimony

of the B. P. is got by boiling black antimony with sublimed sulphur and caustic soda, neutralising the solution with sulphuric acid, and washing the precipitated sulphide, which is mixed with a small but variable amount of oxide, and has the formula, $Sb_2 S_5. Sb_2 O_3$. The following sulphides are used in the arts, and have occasionally been employed in medicine:—glass of antimony, a red transparent body, consisting of about eight parts of sesquioxide and one of sesquisulphide; liver of antimony, a double sulphide of antimony and potassium; and Kermes mineral, a red-brown powder containing a variable proportion of sesquioxide and sesquisulphide.

Actions and Uses.—Being uncertain, irregular, and often violent remedies, the antimony sulphides are not now used in human medicine, and should be discarded from veterinary practice. Their irregular action mainly depends on their variable composition and their insolubility in water. They once had the reputation of being alterative and anthelmintic, and were given to horses and cattle in doses of one to three drachms, usually along with sulphur or nitre. They cause emesis in dogs.

Antimony Terchloride Solution. Chloride, Terchloride, or Muriate of Antimony. Liquor Antimonii Chloridi. Oil or Butter of Antimony. $Sb\,Cl_3$.

When native sulphide is boiled with about five times its weight of hydrochloric acid, hydrogen sulphide is evolved, and the chloride remains in solution—a transparent yellow-red liquid, with a specific gravity of 1·47. The colour darkens by exposure, depending upon oxidation of the iron chloride, which is apt to occur as an impurity. Containing excess of hydrochloric acid, it has an acid reaction, and fumes on exposure to air. Addition of water separates a white precipitate of oxychloride ($Sb\,O\,Cl$), which, if persistently washed, yields the sesquioxide. The true butter of antimony—a hard, white, crystalline, fusible solid—is got by evaporating and then distilling the commercial solution.

Action and Uses.—Although less used than formerly, the chloride solution is still employed us a caustic for thrush,

canker, and luxuriant granulations; and for foul in the feet of cattle, and foot-rot in sheep. Except in cautious hands, it is, however, too energetic for general use; and as it cannot be diluted with water without undergoing decomposition, it should be mixed with an equal quantity of compound tincture of myrrh.

ANTIMONY TARTRATE. Potassium and Antimony Tartrate. Antimonium Tartaratum. Tartarised Antimony. Tartar Emetic. $(K\ Sb\ O.\ C_4\ H_4\ O_6)_2 + H_2\ O$.

To prepare tartar emetic the native sulphide is converted into chloride by heating with hydrochloric acid; the chloride is decomposed by excess of water, and the resulting oxide purified by washing with water and an alkaline carbonate. With this moist oxide is mixed cream of tartar and water sufficient to form a paste. To insure complete combination, the mixture is set aside for twenty-four hours; is then boiled with water for fifteen minutes, and filtered; the clear filtrate, as it cools, deposits crystals of tartar emetic. In this process the radicle oxide (Sb O. Roscoe) displaces the H in the cream of tartar—$2\ K\ H.\ C_4\ H_4\ O_6 + Sb_2\ O_3 = 2\ K\ Sb\ O.\ C_4\ H_4\ O_6 + H_2\ O$.

PROPERTIES.—Tartar emetic is sold as a white powder, and in colourless transparent crystals, exhibiting triangular facets, becoming opaque when exposed to the air, and crepitating and blackening when heated. It is devoid of odour, has a sweet, styptic, metallic taste; is insoluble in strong alcohol; sparingly soluble in proof spirit; and dissolves in about fifteen parts of water at 60°, and two at 212° Fahr. The watery solution reddens litmus; spoils if long kept; is decomposed by strong acids, alkalies, alkaline earths and their carbonates, and consequently by most spring waters, as also by decoctions of cinchona, galls, and other tannin-containing substances. Iron oxide, the most common impurity, communicates to the salt a yellow or brown colour; cream of tartar diminishes its solubility. Purchased in crystals instead of powder, impurities are more readily discoverable.

TESTS.—Tartar emetic is identified by its acidulated solution giving with hydrogen sulphide an orange-red precipitate of

amorphous antimony sulphide, which is blackened by heat, and, unlike the arsenicum sulphide, is soluble in strong hydrochloric acid. From solution of the chloride, water precipitates the oxychloride, yielding the oxide by washing. From coloured organic solutions, antimony salts are separated by boiling with hydrochloric acid and copper clippings, as in Reinche's process for separating arsenic. Metallic antimony is deposited on the copper slips, which are washed, placed in a test tube, and heat applied, when the white oxide slowly volatilises, condenses low down in the tube, and, unlike the arsenious oxide, is amorphous, insoluble in water, and unaffected by silver ammonio-nitrate. Another ready method of separating antimony, corresponding to Marsh's arsenic process, is to add to the solution zinc and sulphuric acid, which cause evolution of antimoniuretted hydrogen ($Sb\,H_3$), which may be ignited as it passes from a gas jet. A piece of cold glass or porcelain held in the flame speedily becomes coated with a black mirror of metallic antimony, which may be identified by its insolubility in a solution of bleaching powder, in which the analogous arsenicum spot is freely soluble, and by dissolving it in acidulated water, and treating the solution with hydrogen sulphide.

Actions and Uses.—Tartar emetic is a topical irritant. Applied to the skin it causes eruption of papules, which shortly become pustules. Poisonous doses produce gastro-enteritis. Medicinal doses given to dogs and other carnivora are emetic, expectorant, cardiac sedative, and diaphoretic; but exert no such actions, nor indeed any definite physiological effect on horses and cattle. It is occasionally used externally as a counter-irritant.

General Actions.—**Different animals are differently affected.** Amongst horses and cattle it does not cause the vomiting or even the nausea and depression so notable in man, dogs, cats, or pigs. Dogs receiving two to four grains are nauseated, and vomiting occurs usually within fifteen minutes. Emesis depends upon irritation both of the stomach and vomiting centre. Reflexly from the stomach, as well as by acting directly on the heart and vessels, it produces in men and carnivora cardiac and vascular depression, with lowered blood-pressure, relaxation of voluntary and involuntary muscles,

and increased secretion from the skin, bronchial and gastro-intestinal mucous membranes. It is eliminated by the mucus of the stomach and bowels, and also by the bile and urine. It increases the excretion of urea.

THE TOXIC EFFECTS, like the general actions, differ in different animals. Dogs, cats, and pigs are acted on much in the same way as men. **Dogs** receiving six grains and upwards if left to themselves speedily get rid of the irritant by vomiting. If the œsophagus, however, be tied so as to prevent vomiting, such doses cause nausea, accelerated and difficult respiration, fluid dejections, gastro-intestinal inflammation, and death in a few hours. Dr Alfred Taylor, in his volume on *Poisons*, records that three to six grains injected into the jugular vein of dogs causes death in eight or ten hours. Hertwig (*Arzneimittellehre*) mentions that it is not so active in **pigs**; that ten to twenty grains cause nausea and vomiting, but act neither very rapidly nor very certainly; that one drachm in solution, given to a boar nine months old, caused vomiting, dulness, and uneasiness, which continued for three days; but that two drachms given to a similar animal killed it within twenty-four hours.

Large doses alike in warm and cold blooded animals paralyse the spinal cord, while continued doses produce fatty degeneration of various organs. As with arsenic, animals getting small doses acquire a condition of **tolerance,** and with impunity take doses which would otherwise prove dangerous. (Dr Lauder Brunton.)

The **antidotes** consist in removal of any unabsorbed poison by promoting vomiting or using the stomach pump, and subsequently giving tannin-containing solutions. Demulcents abate gastric irritation, which, with irritation of the vomiting centre, may also be relieved by morphine and chloral, while tendency to collapse is treated by stimulants.

Although notably irritant and emetic in man and carnivora, tartar emetic exhibits negative effects when given in medicinal doses to **horses, cattle, sheep, or rabbits.** Horses and cattle resist entirely its emetic action, and are brought under its irritant and cathartic effects only by administration of three or four ounces given in solution. Half an ounce has very slight

effect on **the horse,** even when repeated two or three times daily during several days. It does not induce nausea; it improves rather than injures the appetite; neither augments nor diminishes the evacuations, and disturbs neither circulation nor respiration. These statements, although somewhat at variance with the generally received opinion, and with the results of various experiments made at Alfort, and reported in the *Veterinarian* for 1847, are fully borne out by a number of experiments made at the Royal (Dick's) Veterinary College by the late Mr Barlow and myself. Some of these experiments are subjoined :—

Case I.—On 9th September 1852, about 10 A.M., a brown mare, unfit for work on account of lameness, with the pulse 38 and respirations 7, got three drachms of tartar emetic in a ball made up with treacle and linseed meal. In the evening the pulse was unaffected, and the dose was repeated.

10th.—The pulse was 40, the respirations 7, appetite good, bowels and kidneys regular. A dose of four drachms was given morning and evening.

11th.—At 10 A.M. the pulse was 42, respirations 7, appetite and bowels quite normal. Got an ounce in a ball as before. In the evening the pulse was 40, no perceptible nausea, appetite good, bowels and kidneys regular. Dose of an ounce repeated.

12th.—In the morning the pulse was 37½, somewhat weaker than yesterday, but still firm. The appetite was very good, and there was no change in the state of the kidneys or bowels. Got a dose of an ounce. In the evening the pulse was 40, and the patient in other respects as in the morning. Gave an ounce, being five ounces six drachms in four days.

13th.—At 10 A.M. the pulse was 35, the appetite good, and the bowels and kidneys normal. About 1 A.M. the animal had dropped or lain down, and while lying the pulse was somewhat irregular, varying between 60 and 70. The respirations were quiet. At 12 the animal was lifted, when the pulse fell in a few minutes to 55, and the respirations to 6. The appetite still remained very good. Gave ten drachms in the usual way. In the evening the pulse was 40, the respirations 6, the appetite and evacuations natural; gave fourteen drachms.

14th.—10 A.M. No change from last night. Got an ounce; but when having it put over, the animal ran back, and went down. At 1 she was raised, still continued to eat, and at 1.30 got another dose of an ounce. She remained down all day, and appeared nauseated. The pulse was not quite regular, probably owing to occasional struggling, but reached about 60 when at its maximum. Respirations about 12. At 6.30 the animal was still eating and drinking, but only sparingly; was much nauseated, and lying pretty quiet, with the lips much retracted, and the pulse 75 and weak.

15th.—10 A.M. Found dead, having taken ten ounces and six drachms of tartar emetic in six days. Mr Barlow made the following notes of the post-mortem examination :—The muscular tissue in every part of the body was unusually flaccid, although rigor mortis was well established. The right lung, which was lowermost as the animal lay, was much congested in its deeper and central parts; the several margins were comparatively pale;

at the anterior part of the anterior lobe there was much emphysema. The left lung was perfectly healthy, and not at all emphysematous. The bronchial tubes and smaller bronchi in both lungs contained frothy mucus. The pleura and pericardium were in every way healthy. The heart was very large, in consequence of all its cavities being filled with firmly coagulated blood. At the junction of the villous and cuticular coats, the stomach was much contracted, and exhibited a slight blush, not amounting to redness. The cuticular coat was marked with several indentations, such as are produced by bots; but in all other respects the stomach was perfectly healthy. The intestines were also perfectly healthy, both within and without. The liver was in a state of cirrhosis, such as is often seen in old and worn-out horses. The organs of urination and generation were quite normal. The brain was healthy, but the sub-arachnoid spaces contained a considerable quantity of fluid.

Case II.—A mare, about 16 hands high, and in good health and condition, got three drachms of tartar emetic daily, in the form of bolus, for five days, and then four drachms daily for thirteen days,—making in all ten ounces and three drachms in eighteen days—but without exhibiting any physiological effect. The animal was destroyed by cutting the carotid artery, but the post-mortem examination discovered nothing at all abnormal. It may be mentioned that, on the twelfth day of experiment, twenty ounces of urine were removed, and found to contain a perceptible, but not very large, quantity of antimony.

Case III.—A black mare, of sound, healthy constitution, took ten ounces and a half of tartar emetic (in doses of four drachms, repeated twice and thrice a day) during ten consecutive days; yet she was in no way affected by it: her pulse and respiration were scarcely at all altered; her appetite throughout was voracious; her evacuations natural in appearance and quantity; and her condition considerably improved. She was poisoned by a fluid drachm of Fleming's tincture of aconite. On dissection, not a single morbid appearance referable to the tartar emetic was observed. The stomach and intestines were carefully examined, and found "beautifully healthy."

Case IV.—A healthy, well-bred horse got ten ounces of tartar emetic in solution, and after showing a good deal of nausea, uneasiness, and pain, died in about six hours. The only notable appearances on post-mortem examination were softness and vascularity of the intestines, analogous to what is seen in patients that have died while affected by diarrhœa. Neither in this nor in any of the other cases were the lungs congested or inflamed, as is said to have occurred in Majendie's experiments.

These cases, with others of a similar kind, demonstrate that single doses of tartar emetic, sufficient, if retained in the stomach, to destroy from thirty to forty men, or as many dogs, may be given to horses with impunity; that doses of one to four drachms may be administered to them in the solid form for days, or even weeks, without producing any very obvious physiological effects; and that several drachms, even when given in solution, in which the medicine is certainly more active, fail to depress the action of the heart or diminish the frequency of the respirations.

Cattle, like horses, take very large doses without exhibiting any of its physiological actions. Hertwig and Viborg gave quantities varying from two to ten drachms, and Gilbert gave ten drachms in solution—all without effect. (Hertwig *Arzneimittellehre.*) I have repeatedly administered an ounce twice a day to cattle, and, except in a few cases where purgation occurred, have watched in vain for any evidence of its action. Mr Balfour, V.S., Kirkcaldy, informed me that he has given half-a-pound in solution without any very obvious effects. **Sheep** are equally insusceptible to the action of tartar emetic. Viborg gave one drachm, and Gilbert three drachms in solution, and four in the solid state, without effect. (Hertwig.) But Gilbert found that four drachms in solution destroyed a one-year-old sheep. This insusceptibility of horses, ruminants, and rabbits, especially to the emetic and nauseating effects of tartar emetic, apparently results from the position of their stomachs and the imperfect development of their vomiting centres (p. 79.)

MEDICINAL USES.—As tartar emetic produces no marked physiological actions on horses and cattle, it can scarcely exert any marked curative effects on these animals. The febrifuge and sedative virtues formerly ascribed to it were doubtless the result of medicinal or hygienic remedies with which it was used. It is still occasionally given as a vermifuge to horses along with aloes, to cattle along with Epsom salt; it increases the activity of such purgatives, but has no special vermicide action.

When the stomach of the dog, cat, or pig is to be emptied of undigested food, irritants, or poisons, ipecacuanha, mustard, or zinc sulphate is preferred on account of their being more prompt and less nauseating. But tartarised antimony is occasionally used as a nauseating emetic for robust subjects at the outset of febrile and inflammatory complaints. It promotes copious bronchial and gastric mucous secretion, and relieves engorgement of the stomach, liver, throat, and chest. It hence mitigates the early acute catarrhal symptoms of distemper, and relieves bilious attacks in pampered plethoric dogs.

As an **external irritant,** unless employed with much caution, it is apt to induce painful, deep-seated inflammation,

sloughing, and blemishing; and is consequently unsuitable either for horses or dogs. For cattle, however, it is sometimes applied as a pustulant in chest diseases and chronic rheumatism. Unlike cantharides, it does not act on the kidneys; but if it be absorbed, it produces in dogs, cats, and pigs nauseating effects similar to those which follow its administration by the mouth.

Doses, etc.—When given to horses or cattle with the view of producing sedative, alterative, or expectorant effects, ʒi. to ʒiv. are administered three or four times daily, either in bolus or solution. It used to be sometimes conjoined with nitre, Epsom salt, calomel, or aloes. As an emetic for dogs or cats, gr. i. to grs. iv., and for pigs, grs. iv to grs. x. are given in bolus or rolled in a piece of meat, but are most effectual when dissolved in tepid water. One to two grains, with about the same quantity of calomel, or twenty grains of jalap, are sometimes given to strong dogs at the outset of inflammatory complaints. Such a mixture causes vomiting, and subsequently purging, accompanied by cardiac and vascular depression. Doses considerably less than one grain, and sometimes conjoined with ipecacuanha, regulated so as to produce diaphoresis, with very slight nausea, are occasionally prescribed for carnivora as antipyretics and expectorants in acute attacks of bronchitis and pneumonia.

Externally it is occasionally used in the form of saturated **watery solution** or of **ointment,** which is made with one part of tartar emetic and four of lard, and is sometimes added to ordinary blisters to increase their activity. A few grains are occasionally scattered over Burgundy pitch and other warming plasters. **Antimonial wine** is prepared by dissolving forty grains tartar emetic in a pint of sherry

ARECA-NUT.

Arecæ Semina. Seeds of Areca Catechu. Betel-nut.
Nat. Ord.—Palmacæ.

The catechu or betel-nut palm is a straight, slender tree, forty or fifty feet high, growing on the Coromandel and Malabar Coasts, and throughout the warmer parts of Asia.

Within a fibrous fruit lies the hard, ovoid, red-brown seed, of the size and appearance of a nutmeg. When ground, the powder is brown, astringent, and partially soluble in hot water and spirit. It contains fatty matters, gum, and about 14 per cent. of areca-red and amorphous tannic matter, slightly soluble in water, yielding by destructive distillation pyro-catechin, and producing a dark purple precipitate with ferrous sulphate in presence of an alkali. A portion of arecu-nut rolled up with a little lime in the aromatic pungent leaf of the Piper betel, constitutes the betel or pawn so extensively chewed in Eastern countries.

Actions and Uses.—Areca-nut is an **astringent** resembling catechu, and an effective **vermicide,** especially for dogs, proving destructive alike to tape and round worms. Although not so certain in horses and cattle, it is the most effectual vermicide for dogs. Mr Hanley (*Veterinarian* for May 1862) states that he gave a bitch, which had fasted for twenty-four hours, two drachms of powdered areca-nut in milk. In fifteen minutes she passed a mass of tape-worms, varying in size from one inch to three feet, and numbering forty-three, each being stated to have a perfect head ! Mr Hanley also records the case of a greyhound bitch, which passed, after the use of the nut, a tape-worm thirteen yards and two feet long. Such rapid riddance of the worms is not, however, always attainable; and it is usually desirable to conjoin with the areca ♏x. to ♏xv. of male shield fern fluid extract. This combination, Professor Williams testifies, is the most effectual remedy for tape-worm in dogs. If the parasites are not removed, a second dose of the mixture should be given several days later. If the results are still unsatisfactory, the patient is vigorous, and the bowels not unduly relaxed, a moderate dose of castor oil and turpentine will sometimes bring away worms that were previously immovable.

Doses, etc.—For dogs, grs. xv. to ʒij.; for horses, ʒiv. to ʒvi. It is convenient to note Mr Mayhew's observation that the dose of the powder for the dog is about two grains for every pound of the animal's weight. It is administered in soup, mucilage, or milk, to the last of which worms are particularly partial. Previous to the administration of areca

to a verminous patient, the bowels should be cleared out by any simple laxative, and their further emptiness insured by several hours' fasting. The parasite, thus starved, greedily swallows the poison prepared for it.

ARNICA.

ARNICÆ RHIZOMA. The dried rhizome and rootlets of Arnica montana. B. P. Leopards' Bane. Mountain Tobacco. *Nat. Ord.*—Compositæ.

Arnica montana is a perennial, growing in many of the mountainous parts of central and southern Europe, and also in Asia and America. It has a hairy stem about one foot high, composite yellow flowers, used in America for making the tincture, obovate leaves, and a cylindrical contorted brown root, one to three inches long, two or three lines thick, distinguished by a peculiar aromatic, offensive odour, and a bitter, peppery, acrid taste. It contains mucin, extractive matter, two volatile oils, and an active bitter yellow amorphous principle, **arnicin,** and probably also tri-methyl-amin—a colourless alkaline, irritant fluid, boiling at 49° Fahr., with a fishy odour, and also present in ergot, guano, and other vegetable and animal bodies.

ACTIONS AND USES.—Arnica is irritant and stimulant, has been credited with alterative properties, and is used externally as a stimulant for strains, bruises, and wounds.

Viborg gave a horse six drachms of the flowers in infusion, and records production of quickened circulation and diuresis. Professor Williams recommends one to two ounces of the tincture in congestion of the lungs and lymphangitis in horses, stating that it stimulates cutaneous circulation. Other practitioners have administered it in the second stages of pleurisy, in weakness of the loins, in muscular strains, and in rheumatism. Mr Dollar, of New Bond Street, London, has, however, repeatedly tried it, without benefit, in horses suffering alike from acute and chronic rheumatism. In the several forms of rheumatic kennel lameness in dogs, and in stiffness produced from over-exertion, it has been employed both externally and internally. It is a favourite homœopathic remedy.

Externally, arnica is a popular healing remedy in strains, bruises, and wounds, and especially in broken knees and sore shoulders. An ounce of the tincture is dissolved in twelve to twenty ounces of cold water. A more effectual lotion is made with a drachm of arnica tincture and one or two drachms of zinc sulphate or lead acetate diluted with ten or twelve ounces of water. For painful or irritable wounds the tincture is employed with chloroform, belladonna tincture, or laudanum, diluted with water according to circumstances. Along with liberal feeding and tonics, a drop of arnica tincture placed daily within the eyelids is one of the remedies for those troublesome ulcerations of the cornea which affect weakly dogs recovering from distemper. Arnica has, however, been over-estimated; the evidence of its value as an internal remedy requires confirmation, while the healing properties ascribed to it appear to depend on the other drugs, spirit, or cold water, with which it is generally used.

Doses, etc.—Horses take f℥iv. to f℥i. of the tincture; cattle, double that quantity; dogs, ♏v. to ♏viij., mixed with water, ale, or gruel. The flowers, leaves, and root, are occasionally used powdered, especially for making poultices; the **tincture** is usually made with an ounce of the coarsely powdered root to a pint of rectified spirit. Watery infusions can be of little efficacy, for neither the arnicin, volatile oil, nor tri-methylamin are soluble in water.

ARSENIC.

Arsenicum Album. Arsenious Anhydride. Arsenious Acid. White Arsenic. Oxide or Sesquioxide of Arsenic. $As_2\ O_3$.

Arsenic is found associated with iron cobalt and nickel sulphides, constituting arsenides and arsenio-sulphides. Mispeckel ($Fe\ S_2.\ Fe\ As_2$) obtained from the mines of Silesia and Cornwall is its most common source, is roasted in ovens, iron oxide and sulphide remain, while the crude arsenious anhydride is conducted into condensing chambers, and purified by sublimation. When the anhydride is heated with charcoal, the metal arsenicum (As) is obtained, resembling in its affinities and properties, phosphorus, and the triatomic metals,

antimery, and bismuth. It forms two series of salts:—the arsenious or triatomic arsenites ($Na\ H_2\ As\ O_3$), and the less soluble and less poisonous penatomic arsenates ($Na_2\ H\ As\ O_4$. 7 Aq.)

Properties.—The anhydride, white, or common arsenic used in medicine, as well as in the manufacture of glass, colours, and shot, is generally met with as a lustrous white powder, of the spec. grav. 3·8, consisting of minute glassy fragments and octahedral crystals. It is odourless and tasteless, rough and gritty between the teeth, and if held in the mouth shortly causes irritation. When long kept it loses its transparency, and becomes opaque. At a temperature not exceeding 400° Fahr. it is entirely volatilised. Sprinkled on a red-hot coal or shovel it is decomposed; and the metal in vapour gives off a characteristic garlic odour. Arsenic is very sparingly soluble, either in water or alcohol. A pint of cold water at 60° does not take up more than 20 grains; a pint of boiling water added to arsenic, and allowed to cool, takes up 22 grains; but when boiled in water for two or three hours, the ordinary crystalline arsenic is converted into the vitreous form, and in each pint 219 grains are dissolved. (Bloxam.) Solubility is diminished by organic matters, but increased by acids, alkalies, and alkaline arsenites.

Tests.—Arsenic is readily identified—(1) by sublimation, producing the characteristic crystals of sesquioxide; (2) by reduction developing a distinctive mirror of metallic arsenic, which may be again oxidised; and (3) by chemical reactions in solution.

1. A few grains of arsenic, placed in a common test tube, and heated in a spirit-lamp flame to about 380°, sublime unchanged, and condense again in the cool part of the tube in shining crystals, which, examined with a pocket lens, are found to be regular octahedrons, or portions of such octahedrons exhibiting facets which are equilateral triangles. The corresponding antimony oxide, with which arsenic may be confounded, is less volatile, and condenses slowly in needles low down in the tube.

2. A mixture of arsenic and dry charcoal, a little cyanide of potassium, or, still better, some black flux, which is a mixture of carbon and potassium carbonate, obtained by heating cream of tartar in close vessels, is introduced into a test tube, the size of a crow quill, or into one of those tubes specially made for testing arsenic, and having a narrow neck and small bulb. The mixture being heated to redness, oxygen is abstracted from the arsenious oxide, and metallic arsenicum volatilises as a colourless gas with a distinctive garlic odour, and condenses in the narrow part of the tube, forming a brilliant steel-grey incrustation. This is dark-coloured and smooth externally, and lighter and more crystalline, rough, and shining internally. When the narrow part of the tube is cut out, placed in a

common test tube, and heated, the arsenicum regains the oxygen previously lost, and a crust of white arsenic in the characteristic octahedral crystals forms in the cool part of the tube.

3. When this white crust of sesquioxide is boiled with a little water acidulated with hydrochloric acid, or when arsenic is otherwise in a state of solution, there are three other tests by which it may be readily identified :—(*a*) Hydrogen sulphide, in an acidulated solution, gives a yellow precipitate of arsenious sulphide ($As_2\ S_3$) or yellow orpiment. Arsenious sulphide differs from the yellow persulphide of tin in being soluble in ammonium carbonate, unlike the yellow cadmium sulphide, it is soluble in alkaline solutions; unlike the orange-coloured antimony sulphide, it is insoluble in hydrochloric acid. (*b*) Silver ammonio-nitrate (prepared by adding ammonia to silver nitrate dissolved in about forty parts of water until the precipitate which first falls is almost wholly re-dissolved) gives a primrose yellow precipitate of the silver-arsenite ($Ag_3\ As\ O_3$). (*c*) Cupric ammonio-sulphate (prepared in a similar manner to the silver ammonio-nitrate) gives an apple-green precipitate of copper arsenite ($Cu\ H\ As\ O_3$), largely used as a pigment, and commonly known as Scheele's green. Both the silver and copper arsenites are soluble in ammonia and nitric acid. Although these liquid tests, when taken individually, are not quite free from fallacy, still all of them together afford adequate evidence of the presence of arsenic; and this evidence is of course still further strengthened by obtaining the distinctive crystals of white arsenic, and afterwards reducing them to the metallic state.

When arsenic, in combination, is present in the contents of the stomach, the tissues of the body, or in coloured organic mixtures, the tests mentioned are inapplicable until the arsenic is isolated. To effect this, the following **processes** are in common use :—

1*st.* The mixture is boiled with addition of water if necessary. It is then filtered, acidulated with hydrochloric or acetic acid, subjected to a stream of hydrogen sulphide, and again boiled. A yellow precipitate of arsenic sulphide or orpiment gradually appears, and its nature may be readily demonstrated by washing, drying, and heating it in a tube as above described, with a mixture of charcoal and potassium carbonate, when metallic arsenicum volatilises, oxidises, and condenses in the characteristic crystals of white arsenic, which may further be reduced to the metallic state, or subjected to the liquid tests already mentioned.

2*d.* The mixture is acidulated with pure hydrochloric acid, and boiled with a few clean copper clippings, on which there collects a steel-gray coating of arsenide of copper. The clippings are put into a test tube, and cautiously heated until a ring of white arsenic lines the cool part of the tube. Indubitable evidence of the nature of this sublimate may be had by dissolving it in acidulated water, and applying the tests for arsenic in solution. This is generally known as Reinsch's process, and it is so delicate that it will detect 1-250,000th part of arsenic in solution. (Christison.)

3*d.* The mixture placed in a Wolf's bottle, a Döbereiner's lamp, or other convenient apparatus, is treated with zinc and sulphuric acid (which must themselves be free from any traces of arsenic, as ascertained by the hydrogen they evolve being uncontaminated by arseniuretted hydrogen). Hydrogen is set free from decomposition of the water, and unites with the arsenicum of any arsenical compound present. The arseniurretted hydrogen or arsenious hydride ($As\ H_3$) so formed may be decomposed by heating with a spirit lamp the glass tube through which it is passing off, when a crust of metallic arsenic is deposited, and may be subjected to

examination in the usual way. Or, if the end of the exit tube be narrowed, and the gas ignited, it burns with a livid blue flame, while a piece of glass or porcelain held over the flame soon becomes incrusted, either with metallic arsenic or arsenious acid, according to the distance at which it is kept from the flame. This elegant method of extracting arsenic from complex fluids is called Marsh's process. The late Mr Morton, of the Royal Veterinary College, proposed a very delicate and ingenious method of evolving arseniuretted hydrogen from fluids containing arsenic, without the use of zinc and sulphuric acid, by passing a galvanic current through them. The gas thus evolved is subjected to the same examination as in Marsh's process.

4th. The fluid is placed in a retort together with some common salt, sulphuric acid is added in small portions through the tubuline and heat applied. Chloride of arsenic distils over together with water and collects in the receiver, the contents of which are submitted to any of the foregoing tests, preferably to No. 3.

The quantitative estimation of arsenic is generally determined by ascertaining the number of grain measures of the standard solution of iodine which the arsenical solution decolorises.

ACTIONS AND USES.—Arsenious acid is a corrosive irritant poison. Continued doses cause fatty degeneration. It is prescribed as a gastro-intestinal tonic, stimulant and alterative, acting especially on the digestive and respiratory mucous membranes and skin, as an antiperiodic and tonic, and an antispasmodic in nervous diseases. It is used externally as a stimulant, caustic, antiseptic, and antiparasitic.

TOXIC EFFECTS.—Poisonous doses in all animals cause irritation, inflammation, and sloughing of any mucous or abraded skin surface, with which it is brought into contact. In frogs it softens the protoplasm of the columnar cells of the epidermis, which accordingly can be readily stripped off. A similar fatty degeneration is also often observed in the epithelial lining of the alveoli of the lungs of animals poisoned by arsenic. It is absorbed from any mucous or skin abraded surface, and exerts its effects by whatever channel it enters the body. Full doses cause **gastro-intestinal irritation,** colicky pains, and diarrhœa, with mucous evacuations, occasionally tinged with blood. Still larger doses quickly cause gastro-enteritis, with violent purging, vomiting in dogs and other carnivora, cramps of the limbs, and collapse.

Beginning with small doses, animals shortly acquire a **tolerance** of arsenic, and take with impunity doses which would prove fatal to those not accustomed to them. Like phosphorus and antimony, continued full doses lead to **fatty**

degeneration, which, in pigs, fowls, and rabbits, in three or four weeks attack even the bones. It is quickly eliminated chiefly in the urine, and to a less extent by the bile and perspiration.

All arsenical compounds are **poisonous,** and the most soluble are the most active. Deadliest of all is arseniuretted hydrogen, which has occasioned the death of three chemists, who were so unfortunate as to inhale it. Orfila found that the sulphides, in doses of forty to seventy grains, destroyed dogs in two to six days, and had much the same effect whether they were swallowed or applied to a wound. Metallic arsenic, although itself innocuous, unites so readily with hydrogen and oxygen, that it speedily acquires poisonous activity.

The toxic dose for the horse is liable to considerable variation. Berthe gave a mare affected with inveterate mange two, and afterwards three, drachms without injury.—(*Recueil de Médecine Vétérinaire,* Oct. 1825.) Beissenhirz gave one, four, three, two, and eight drachms, on successive days; but death occurred twenty-four hours after the last dose.—(Pereira's *Elements of Materia Medica.*)—Hertwig gave eight horses doses, beginning with 20 grains and gradually increasing to a drachm; continued the administration in some cases for thirty days, in others for forty days, but observed no bad consequences, either during the use of the poison or afterwards; the pulse became a little stronger and harder, and some of the animals improved in condition.—(*Praktische Arzneimittellehre für Thieraerzte,* Berlin, 1847, p. 656.) Mr William Percivall, experimenting on a horse affected with glanders, began with one drachm daily, made into bolus with linseed oil and treacle; increased this dose by 20 grains per day, and continued the medicine for seventeen days, when the animal got, in one dose, 380 grains, and had then taken upwards of seven ounces of arsenic. Yet no physiological effect was obvious, no loss of appetite, no uneasiness or pain, and no alteration of the pulse or respiration. —(*Veterinarian* for 1843, p. 347.)

Although such large doses sometimes have little effect, much smaller doses occasionally act with greater violence. Thus Gerlach saw twenty grains cause active diarrhœa; and Mr Percivall mentions that two glandered horses, getting five

grains daily in bolus, were attacked, one on the eighth, the other on the ninth day, with shivering, loss of appetite, nausea, purging, and other symptoms of abdominal irritation, imperceptibility of the pulse, and prostration of strength. One died, the other recovered.—(*Veterinarian* for 1843, pp. 349-351.) These very different effects depend partially on varying susceptibility; mainly on the amount of food present in the alimentary canal; on the fact that animals, receiving arsenic regularly, gradually acquire a tolerance of it, and take with impunity at one dose as much as would kill a patient unused to it; whilst large doses moreover produce inflammatory changes in the coats of the alimentary canal which greatly retard absorption. Arsenic given in solution, is, however, more certain, regular, and active than in the solid state. Thirty grains given daily, dissolved in potassium carbonate, destroyed a horse in four days.—(*Veterinarian*, 1843, p. 350.)

Mr Baldwin, in the *Veterinarian* for January 1858, reports the case of six horses poisoned by drinking from a pail in which some arsenical sheep-dipping mixture had been dissolved. Two died; and there were found, on examination, inflammation of the mucous coat of the stomach, and patches of inflammation extending throughout the whole alimentary canal. The others suffered from dulness, colicky pains, and purging, the pulse was upwards of 70 and wiry, the extremities cold, the visible mucous membranes highly injected. One mare was ill for three or four days. The treatment consisted of opiates and lime-water.

Eleven cart-horses were poisoned at Edgeware in August 1874, from drinking water containing arsenic.—(*Veterinarian*, Sept. 1874.) They had been drawing heavy loads of building materials fully eight miles from London, were tired, and their stomachs empty, which doubtless accounts for the rapid and serious results. Although arsenic is not known to have proved fatal in the human subject under seven hours, one of those horses dropped and died ten minutes after drinking, and several were dead within an hour. The symptoms recorded were colic, staggering gait, pallid membranes, cold ears, pulse 40 to 60, breathing quickened, and latterly coma. Brandy and ammonia were the remedies prescribed.

Cattle take with impunity even larger doses than horses,

for the comparatively insoluble poison mixes with the large bulk of food in the first stomach, and hence tardily reaches the absorbing walls of the fourth stomach; while the small amounts thus gradually introduced into the circulation are continuously excreted, and thus toxic effects are warded off. An ounce of arsenic given with a handful of salt to a strong **sheep** caused most of the symptoms above mentioned as occurring in horses, and death after five days.—(*Veterinarian*, 1843, p. 345.) Hertwig mentions that five to ten grains given to healthy sheep produced the usual symptoms of poisoning; that a second dose of ten to twenty grains, given twenty-four hours after, caused death; and that, on examination, the poison was found in the blood, urine, lungs, liver, and muscles. The carcases of sheep poisoned by arsenic have been eaten by dogs with impunity.—(*Veterinarian*, 1843, p. 345.)

Chronic arsenical poisoning, with symptoms of indigestion, thirst, wasting, and chronic disease of the joints and bones, is sometimes met with amongst both cattle and horses in the neighbourhood of the tin and copper smelting furnaces of Cornwall and Wales. Mr W. H. Michael, of Swansea, one of the witnesses examined before the Select Committee of the House of Lords on the injurious effects of noxious vapours, stated: "I have known rabbits poisoned, and sheep to have died, and especially two or three horses I know to have died. I have seen a great amount of injury done to ponies. The gentleman who occupied the farm of which I am speaking kept several hundred ponies, which he bought very young generally, and fattened them for sale; he was obliged to give up keeping them, owing to the peculiarly starved and shaggy appearance those animals acquired. The knee-joints began to swell, they got lame and hide-bound, the hair fell off, the teeth became black and fell out, necrosis of the bones occurred, and the result was that he gave up grazing on a large tract of land."—(*Report*, 1st August 1862.) Arsenical green paper left in the way of animals has sometimes been eaten in quantities sufficient to cause death. Rabbits at shows have been destroyed by nibbling the bright green prize-cards. An aged donkey is recorded to have died in three hours, poisoned by eating green paper.—(*Veterinarian*, June and July 1865, and July 1871.)

Dogs and cats are more quickly and powerfully acted upon than horses or cattle, and relatively to their weight exhibit about the same susceptibility as human patients, in whom 2·5 grains is the smallest dose known to have proved fatal. Dogs, to which I administered three to ten grains in solution, within a few minutes exhibited nausea, vomiting, moaning, difficult breathing, a wiry rapid pulse of 120 or upwards, and shortly passed black evacuations with considerable pain; while death with convulsions followed in from six to thirty hours. Arsenic produces similar effects on **pigs** and **poultry.** Dogs receiving a quarter of a grain to a grain, repeated twice daily, and continued during eight to fourteen days, exhibit gradually diminishing appetite and increasing vomiting. From the sixth to the tenth day, diarrhœa, lowered temperature, rapid emaciation, and painful cough ensue, and death occurs in twenty or thirty days. Half an ounce of Fowler's solution injected into the jugular vein of a dog, although it caused immediate vomiting, proved fatal in eighteen hours, and left the stomach and intestines reddened and injected. Full doses increase disintegration of albuminoids. A. Kossel gave sodium arsenite to dogs in doses of $1\frac{1}{2}$ to 3 grains for ten days, and found that the amount of nitrogen excreted rose even in inanition to 48 or 60 grains, and in healthy dogs getting arsenic reached 110 to 120 grains.—(*Centralblatt für die Med. Wiss.* No. 18, 1876.)

The **post-mortem appearances** of poisoning by arsenic, although very similar in all animals, differ a good deal with the severity and duration of the case. In the horse the cuticular portion of the stomach is not usually much altered; but the villous portion is reddened, softened, thickened, and disorganised by patches of inflammation and extravasation of blood, which, excepting in rapidly fatal cases, extend into the duodenum, and are also observable in the colon, cæcum, and rectum. The lungs are usually congested, and their mucous membrane, with that of the urino-genital organs, is red and vascular. In chronic poisoning the body becomes dry and mummified, while fatty degeneration affects the epithelial tissues, the brain, lungs, and liver.

In treating acute cases of **arsenical poisoning,** the stomach

must be washed out with copious draughts of tepid water, and emptied, in carnivora by emetics, such as mustard or zinc sulphate, in horses or cattle by the stomach-pump. Iron sesquioxide is the best **chemical antidote,** and is most active when prepared by precipitating an iron sesquisalt with ammonia, washing the precipitate with warm water, and administering it moist and freshly made. Some authorities recommend precipitation of two to three ounces of iron perchloride solution with one ounce of sodium carbonate crystals; these quantities, freshly prepared, suffice to neutralise ten grains of arsenic, converting it into the insoluble iron arsenate ($Fe_3\ 2As\ O_4$). Dialized iron, which has the advantage of being ready in most pharmacies, is nearly as effectual as the sesquioxide or carbonate. Either of these iron antidotes should be given as soon as possible, in repeated doses, at intervals of ten minutes, until a quantity has been swallowed at least twelve times greater than that of the poison. Magnesia in its hydrated or gelatinous form, prepared by precipitating a solution of Epsom salt with caustic potash, also diminishes greatly the solubility of arsenic. Insoluble powders, charcoal and clay, envelop the particles of poison, and retard absorption; but such mechanical antidotes to be of service must be given before, along with, or immediately after the poison. Oils, lard, glycerin, mucilage, and milk exercise similar mechanical effect, and some of these bodies also slightly diminish the solubility of arsenic. Subcutaneous injection of morphine repeated at intervals of fifteen to twenty minutes, in the first stages, retards absorption of the poison, and in later stages antagonises irritation. Demulcents and opium are given to combat gastro-intestinal irritation. In chronic cases oleaginous laxatives and enemata relieve griping and constipation. Easily digested nutritive food helps to sustain the powers of life; while occasional diuretics hasten the excretion of the poison by the kidneys.

Medicinal Uses.—Arsenic is administered in all animals as **a tonic** in irritative dyspepsia and gastralgia, and in cases of diarrhœa, where imperfectly digested food is hurried through the intestines. In such cases it is frequently conjoined with antacids and opium.

It is serviceable in horses in chronic catarrh and ozæna, in promoting recovery from tedious influenza attacks, in hastening removal of lung consolidations, and in relieving irritable cough and roaring in its early stages, as well as thick and broken wind. The late Professor Robertson spoke strongly of its value in roaring, and in abating the dyspnœa and cough of thick and broken wind, enjoined its use daily for ten days or a fortnight, when some other remedy was directed to be substituted, and in broken wind, frequently with advantage, persisted with two to three grains twice a week for months (*Equine Medicine.*) Its efficacy in these **diseases of the air passages** appears to depend upon one or more of these physiological effects: its stimulation of the respiratory mucous membrane, the respiratory centre, or the pulmonary terminations of the vagi, or its antiseptic action.

As an **alterative,** modifying tissue changes, it is prescribed in the earlier stages of tuberculosis, in farcy, maladie du côit, in some cases of anæmia, in rheumatism, in chorea and epilepsy; while in febrile attacks manifesting periodicity, in virtue probably of its **antiseptic properties,** it is sometimes as effectual as quinine. Dr Lauder Brunton believes that the efficacy of arsenic in phthisis depends upon its hastening the removal of the effused products of pneumonia which form a suitable nidus for the bacillus tuberculosis—(*Pharmacology, Therapeutics, and Materia Medica*). Professor Williams prescribes arsenic and nux vomica in farcy. Continental veterinarians in maladie du côit conjoin iron with the arsenic, and alternate with oil of turpentine. In anæmia medicinal doses probably increase both the white and red corpuscles, especially when conjoined, as it usually is, in such cases, with iron. When mixed with freshly drawn blood it retards coagulation and putrefaction, and preserves the globules, and may exert somewhat similar effects when administered internally. The value of arsenic in spasmodic nervous disorders appears to depend partly on its alterative actions, and partly on its diminishing irritability of motor nerves and muscles.

In chronic eczema, psoriasis, impetigo, scab, and mange, it **stimulates the dermis,** hastens removal of morbid epidermal cells, and is advantageously used both internally and externally.

In chronic scaly skin complaints Professor Williams prescribes it with mercury and iodine.

In Styria it is **eaten by the peasantry,** in the belief that it improves the complexion, prevents breathlessness in running or ascending hills, and increases general vigour. In various parts of England, as well as in Southern Europe, small doses are sometimes regularly **given to horses** with the view of improving condition and imparting strength and endurance. So long as it is used cautiously and regularly, the animals appear to be in excellent health, and have fine sleek coats; but when, after being used for several months or for years, the arsenic is withdrawn, they fall off in appearance, and for many months are greatly more difficult to keep in condition. A small portion of arsenic in a thin bag is sometimes attached to the bit, to produce the frothy muzzles which seem to be admired in high-stepping carriage horses. These practices should not, however, be tolerated, for they are attended with much risk of poisoning, and are, moreover, liable to injure the horse's constitution.

Externally, arsenic is occasionally used to eradicate warts and slough out fistulæ and malignant tumours, one-fifth to one-fourth being used with unguentum simplex or other emollient. For the cure of foot-rot, Professor Williams recommends that the affected sheep be slowly driven through troughs containing a tolerably strong solution of arsenic in carbonated alkali. (*Principles and Practice of Veterinary Surgery.*) In solution it is sometimes applied to remove the scurfiness of psoriasis. Used incautiously it causes sloughing, and if absorbed from a raw surface, may produce constitutional effects. In virtue of its **antiseptic** properties it is used in the form of powder solution and soap for the preservation of skins and natural history specimens.

For sheep dips arsenic is much used. Such dips destroy ticks and keds more effectually than solutions of tobacco, spirit of tar, alkaline, and other non-poisonous dips, and are safer and more convenient than mercurial baths or ointments. Two to two-and-a-half pounds of arsenic, with about the same quantities of soda ash or impure sodium carbonate, soft soap, and sulphur are dissolved in 100 gallons of water. Three,

four, and even five pounds of arsenic are sometimes used without evil results. In many parts of England, pearl ash or impure potassium carbonate is substituted for the soda ash, and makes a more cleansing and softening ley. Some flockmasters double or quadruple the quantity of soap, which, with the alkaline carbonate, aids in dissolving the arsenic, while the sulphur whitens and softens the fleece, and also for a considerable time prevents attacks of flies, which are further deterred by addition of a pint or two of naphtha, or of impure carbolic acid. The ingredients are best dissolved in five to ten gallons of boiling water; cold water is added to make up a hundred gallons, which, with careful dripping, will dip about a hundred sheep. The head must of course be kept out of the bath, in which the sheep is held during forty to sixty seconds, is lifted on to a sparred drainer placed over a second tub, or over a trough communicating with the dipping tub, and the wool well squeezed with the hands, and with a scraper such as is used for cleaning horses.

Arsenical dipping mixtures sometimes, however, produce serious, and even **fatal consequences.** A Lincolnshire correspondent several years ago informed me that, after dipping 150 half-bred Leicester hogs, eleven of them died in twenty hours, and several after some days. A greatly more serious case occurring at Burton, in Northumberland, during the summer of 1858, deserves some detailed notice. Mr Black of Burton purchased from Mr J. Elliot, chemist, Berwick-on-Tweed, 15 packets of dipping mixture. Every packet contained 20 ounces each of arsenic and soda ash, and 2 ounces of sulphur, and was directed to be dissolved, with 4 pounds of soft soap, in 3 or 4 gallons of boiling water. With 45 gallons of cold water subsequently added, this made quantity sufficient for fifty sheep. On 14th August Mr Black had 869 sheep dipped in the usual manner; the apparatus and arrangements were good, and the dripping performed with care. In two days, however, the sheep began to die; they were seized much in the same order as they had been dipped, and within a month 850 had perished. The symptoms frequently came on very suddenly; and Mr Bird, the veterinary surgeon in attendance, records that several died in twenty minutes after he had

observed them eating or ruminating, and apparently well. The usual symptoms were dulness and nausea, frothing at mouth, bloodshot eyes, pain in the bowels, the passage of black and bloody urine, laboured breathing, blackening of the skin, with the wool falling off in patches, especially about the back and loins. Post-mortem examination discovered the bowels inflamed, and covered with patches of extravasated blood, the lungs blackened and inflamed, the liver black, soft, and friable, the spleen congested, the bladder empty. Arsenic was found, on analysis, in the stomachs and bowels.

The case came to trial at Newcastle in February 1859, and the jury found a verdict for Mr Black, with damages amounting to £1400. Mr Black's case rested mainly on the fact that his sheep had been carefully dipped in the usual manner, and according to the printed instructions sent out with each packet of the dipping mixture. It was sought to be proved that the mixture might in some way have been improperly made up, and was of such poisonous strength that it had become absorbed through the skin. The poisoning of a donkey which had carried the skins of the dead sheep, some sores and gangrenous patches on the hands and arms of several of the men employed in the dipping, were also adduced as evidence of the undue strength of the mixture.

In defence of Mr Elliot, it was shewn, on the other hand, that thousands of sheep had with impunity been dipped in mixtures of the same strength as that sold to Mr Black; that, indeed, on the same day as the Burton sheep were dipped another gentleman in the neighbourhood used, without any bad effect whatever, eight packages of the same mixture made in the same way, and at the same time. Professor John Gamgee and Dr Stevenson Macadam made various experiments on the subject, using, in two instances, arsenic in the proportion of 28 and 68 ounces for 50 sheep, instead of the 20 ounces present in Mr Elliot's dip. Mr Browning, a professional sheep-dipper in Oxfordshire, who annually passed through his hands several thousand sheep without losing one, for years employed 2½ lbs. of arsenic for 50 sheep, which is exactly double the strength of Elliot's mixture. I made in 1859, and have repeated and verified them since, experiments with dips three and four times

the strength of Elliot's; some of the sheep I kept immersed for several minutes, and had these concentrated solutions well rubbed into the skin. I abstained in several instances from pressing or drying the wool, dipped the same sheep twice within two hours, and several times within a week, and yet failed in destroying or injuring in the smallest degree any one of the sheep subjected to these severe trials.

Arsenical sheep-dipping mixtures obviously **are not absorbed through the sound skin.** Their danger depends on portions of the poisonous fluid being retained by the fleece, from which it drips on the grass or other food over which the animal strays. In this manner undoubtedly the serious mortality at Burton is explained. The sheep were rapidly dipped at the rate of 80 per hour; and, according to the usual calculation, each sheep carries away in its fleece, even after it has been reasonably drained, about a gallon of the fluid, which, of Elliot's strength, would contain nearly 200 grains of arsenic—a quantity sufficient, if swallowed, to destroy eight or ten sheep.

The sheep are turned out hungry, and at once begin to eat; while **the drippings fall on the grass,** which in the Burton case appears to have been still further contaminated by rain during the night following the dipping, freely washing the poisonous solution out of the fleeces on to the pastures. Here it was found in three sods taken up ten days after, and examined by Sir Douglas Maclagan, who failed, however, to find any arsenic in sods brought from an adjoining pasture, where no dipped sheep had grazed. It is evident how the donkey, the two oxen, and the horses shared the fate of the sheep; whilst the drippings, left in the yards before the flocks were turned out, would account for the mortality stated to have also taken place amongst the poultry.

It is an error to suppose that sheep, pigs, or other animals refuse to eat food over which an arsenical dipping mixture with its nauseous soft soap and alkali have fallen. I have seen sheep eat grass watered, for the purpose of experiment, with such solutions, and afterwards die from their poisoned meal. I have known horses, pigs, and poultry die from getting access to yards where recently dipped sheep have been confined. Two colts came under my cognisance poisoned by eating a few

vetches carelessly left in a yard where some sheep had been placed to drip.

Such cases enforce the following **practical precautions**. Yards into which freshly dipped sheep are to be turned should be previously cleared of all green food, hay, and even fresh litter; if perfectly empty, they are still safer. When the dipping is finished, they should be cleaned, washed, and swept, and any of the unused dipping solution at once poured down the drains. Obviously, however, no such poison should be run into drains emptying into pools or streams accessible to live stock. Dipped sheep should remain, if possible, in an airy exposed place, as on a dry road, or in a large open yard. Overcrowding should be avoided, and every facility given for rapid drying, which is greatly expedited by selecting for the operation fine clear sunny weather. On no account should sheep be returned to their grazings until they are dry, and there is no risk of their poisoning the pastures.

DOSES, ETC.—Horses and cattle take grs. i. to grs. vj.; sheep, gr. j. to grs. ij.; and dogs, gr. $\frac{1}{15}$ to gr. $\frac{1}{10}$. When it is desired to produce its local actions on the stomach and intestines, small doses are given before eating; when its absorption is required, it is administered immediately after meals. It is usually given once daily, and persisted with for a week or ten days, when a change of prescription is often desirable. When it causes acceleration or hardness of the pulse, tenderness of the conjunctiva, indigestion, diarrhœa, or other physiological actions, the doses must be discontinued, materially reduced, or given at longer intervals.

It is most active and uniform in its effects when **used in solution,** and is given dissolved either in diluted acid or alkali. The liquor arsenici hydrochloricus contains one per cent. or $4\frac{1}{3}$ grains arsenic in the fluid ounce. **The liquor arsenicalis** or Fowler's solution, the preparation most frequently used in veterinary practice, contains about one per cent., or rather more than $4\frac{1}{3}$ grains to the ounce. The B. P. gives the following instructions for its preparation:—Heat 87 grains each of arsenious acid in powder and potassium carbonate in a flask, with 10 fluid ounces of distilled water, until a clear solution is obtained. When cold, add 5 fluid drachms of tincture of

lavender, and as much water as will make the bulk 1 pint. The dose for horses or cattle is from half-an-ounce to an ounce. **The liquor arsenici et hydrargyri iodidi**, the B. P. imitation of Donovan's solution, contains about one per cent. by weight of arsenious iodide and of mercuric iodide, and is useful in chronic skin and rheumatic complaints, the dose for horses and cattle being 1 to 2 ounces. Professor Williams, after a purgative, and softening the hard cracks with oil and alkalies, treats the scaly eruptions of psoriasis both internally and externally with a triple compound of iodine, arsenic and mercury, each ounce of which contains 1 grain arsenic, 2 grains mercurous oxide, and rather more than 6 grains hydriodic acid *(Principles and Practice of Veterinary Surgery).* Arsenical preparations being generally devoid of taste, are frequently administered in the drinking water, or in mash.

Whether for internal or external purposes, arsenic must be used with great circumspection. Under the Act regulating the sale of poisons, every purchase of arsenic must be registered in a book kept for the purpose ; the purchaser must be of full age, and either known to the seller or to a witness who is also known to the seller ; while to lessen the risks of a white powder being mistaken for flour, or other harmless substance, it is enacted that, unless in quantities of 10 lbs., one ounce of soot, or half an ounce of indigo, shall be mixed with every pound of arsenic.

ARTEMISIA.

ARTEMISIA ABSINTHIUM. Wormwood.
ARTEMISIA MARITIMA. The Santonica or Wormseed plant.
Nat. Ord.—Compositæ (Corymbiferæ).

The Artemisiæ are low shrubby plants, found throughout Europe, characterised by their aroma and bitterness, and comprising the familiar southernwood and tansy, the mildly anodyne lettuce, and the harmless dandelion.

The dried Artemisia absinthium contains a volatile camphoraceous oil—**absinthol,** and a bitter extract, yielding the neutral crystalline **absinthin,** which is a narcotic poison and spinal stimulant, causing in dogs and rabbits trembling, stupor, and

epileptiform convulsions, which may prove fatal. In medicinal doses, it is an aromatic bitter tonic, and a popular remedy for worms. It is the chief active constituent of the liqueur absinthe. Absinthic acid is also present, and is believed to be identical with succinic acid.

The unexpanded minute flower-heads of Artemisia maritima are imported from Russia, contain a volatile oil, a resin, and about two per cent. of a crystalline neutral principle **santonin** ($C_{15} H_{18} O_3$). It is almost insoluble in cold water, is soluble in chloroform, boiling spirits, and solution of potash. It is rendered yellow by sunlight, and gives a violet colour when added to a warm solution of potash in alcohol. Large doses cause in dogs giddiness, vomiting, and convulsions. It is a vermicide, without effect on tæniæ, but destructive to round and thread worms, and less effective in horses than in dogs, to the latter being given in doses of 3 or 4 grains.

ASAFŒTIDA.

A Gum Resin obtained by incision from the living root of Ferula Narthex, Ferula Scorodosma, and probably other species. B.P. *Nat. Ord.*—Umbelliferæ.

The Ferula or Narthex Asafœtida has a massive perennial root, several inches in diameter, black externally, white within; large pæony-like annual leaves, which are cooked and eaten; and a tall, fleshy, flowering stem, often ten feet high, throwing off from near its base branches which terminate in umbels of yellow flowers. The plant, all parts of which emit a penetrating fœtid odour, grows luxuriantly in Persia and the hill districts of Upper India, and several fine specimens have flowered in the Edinburgh Botanic Gardens. When the plants are four years old, the leaves and stems are removed, and six weeks later, towards the end of May, a slice is cut from the upper part of the root. Fœtid milky juice exudes, and two days later concretes and is scraped off. The root is then protected from the sun by a covering of leaves; within the next two days the operation is twice repeated, and after an interval of eight or ten days, the slicing is resumed, and several times

repeated, when the plant is exhausted, after yielding from a half to two pounds of juice, worth 2s. to 4s. a pound.

The yellow-brown tears are mixed with soft earth and made into irregular masses, which are red-brown externally, and within are opaque and milk-white, but gradually change to a dull yellow-brown. Asafœtida has a disagreeable, penetrating garlic odour, and a taste becoming intensely bitter and acrid. It is pulverised with difficulty, is sparingly soluble, but forms an emulsion with water, is dissolved in rectified spirit, and also in potash and ammonia. Besides water, it contains 50 to 60 per cent. of resin; 25 to 30 of gum; about 10 of earthy matters; 3 to 5 of an active alliaceous acrid volatile oil, consisting of two ferulyl sulphides—$2(C_2 H_{11})S$ and $C_6 H_{10} S$.

ACTIONS AND USES.—Asafœtida is a mild stimulant, expectorant, carminative, antispasmodic, and vermifuge. It is speedily absorbed, its disagreeable odour indicating its general distribution; it is eliminated from the pulmonary mucous surfaces, the skin, and kidneys, gently stimulating their secretions. Professor Robertson used asafœtida with aloes and nux vomica in constipation and torpidity of the bowels in horses, and in flatulent colic prescribed the tincture along with oil and oil of turpentine. The spiritus ammoniæ fœtidus, made with $1\frac{1}{2}$ ounce asafœtida, 2 ounces strong solution of ammonia, and 1 pint rectified spirit, is sometimes prescribed in colic and chronic cough. Like other substances containing odorous volatile oils, asafœtida is a vermifuge, but its action is uncertain. It is allied in many of its actions to valerian, and still more closely resembles the two gum-resins, **ammoniac** and **galbanum**, which are scarcely so active, and are chiefly used for making charges and plasters.

DOSES, ETC.—Horses take ʒij. to ʒiv.; cattle, ℥j.; sheep, ʒi.; and dogs, grs. x. to grs. xx. It is given several times a day; may be made into bolus with camphor and ammonium carbonate; is frequently prescribed in draught with watery or alcoholic solution of ammonia; and, to prevent their misappropriation, is usefully added to alcoholic and ethereal preparations intended for veterinary patients.

AXUNGE.

ADEPS. ADEPS PREPARATUS. Hog's Lard. The purified fat of the hog—Sus Scrofa.

To prepare purified lard, the fat about the hog's internal organs is cut into small pieces, is generally beat in a stone mortar, washed with cold water, drained, melted over a slow fire, strained through flannel or coarse cheese-cloth; is kept stirred in a steam-heated pan at about 130° Fahr. until it is clear and free from water; strained again through flannel; and preserved in casks, pots, or bladders. When pure, it is white or yellowish-white, granular, without odour, but with a sweet taste. It melts at about 100° Fahr., forming a clear transparent fluid, which is a good solvent for wax and resins, and when boiled with alkalies forms soap. Like other fats and oils, lard is insoluble in water, slightly soluble in alcohol, but perfectly soluble in ether. Exposed to the air, it becomes rancid, and in this state is unfit for emollient purposes. It contains about 62 per cent. of olein and 38 of palmitin and stearin. Distilled water, in which purified lard has been boiled, when cooled and filtered, gives no precipitate with silver nitrate, indicating absence of common salt; and no blue coloration with iodine solution, proving freedom from starch, of which about 20 per cent. is found in some inferior specimens; 10 per cent. of water is sometimes incorporated; alum and lime are occasionally added to secure whiteness and increase weight; while many brands of American lard are largely mixed with cotton seed oil.

Benzoated lard, preferable on account of its agreeable odour and diminished liability to rancidity, is made by melting purified lard over a water bath, and stirring in one fiftieth part of benzoin. **Suet**—the fat around the kidneys of sheep or oxen—differs from lard chiefly in being firmer, harder, and more difficult to melt. **Horses' fat** is more easily melted, but firmer than that of swine. **Goose grease,** much used as a popular remedy for sprains and bruises, is more fluid, from its greater percentage of olein.

Actions and Uses.—Fats and mild fixed oils, when given without other food, are inadequate to support life; thus dogs, receiving only butter and olive-oil, with distilled water to drink, died in about thirty-six days. In a well-regulated system of diet, fats serve, however, important purposes; along with albuminoids they form cells; they build up the nervous structures, so largely composed of fatty matters; are consumed in the body for the evolution of nervous, muscular, or digestive force, and for the support of animal heat, or, if in excess for these constant requirements, are stored away for investing and protecting internal organs. Fats are emulsionised by the alkaline intestinal secretions, more thoroughly dissolved by the bile, and absorbed mainly through the lacteals. Although small doses are easy of digestion, large quantities disorder digestion, and cause diarrhœa.

Hog's lard is occasionally used as an internal **demulcent,** as an **antidote** for poisoning with alkalies, and as a laxative clyster. It is applied as a **lubricant** in examination of the rectum or uterus, and in cases of parturition. In reducing enlarged joints or bursæ by vigorous rubbing, the hand is occasionally moistened with lard to prevent undue skin irritation. In congested, inflamed, thickened, and indurated states of the skin, when the sebaceous and sudoriparous glands act tardily, the application of lard, bland oil, or vaselin usefully replaces the deficient natural oil, and protects abraded surfaces from the action of air or of acrid discharges. Most animal and vegetable fats, freely used, and remaining long in contact with the warm skin, oxidise, and become rancid and irritating. Such results are retarded by addition of a little benzoic acid, and are obviated by the substitution of the mineral vaselin. Lard is occasionally employed as a dressing in mange and scab, but is ineffectual in destroying the acari. It is much used for making ointments and liniments.

BARLEY.

Hordeum. Pearl Barley. Malt.
Nat. Ord.—Graminaceæ.

Barley is used for feeding most of the domesticated animals;

and, when stripped of its outer husk, is recognised by the B. P. as **pearl barley.** Ground to meal, it is used for making poultices and infusions. Good **barley-meal** contains 68 per cent. of starch, 14 glutin and albumin, 2 fatty matter, 2 saline matters, and 14 water. When moistened and exposed to a temperature of about 100° Fahr., barley germinates, the starch in great part being converted into dextrin and sugar, and if the process be arrested by drying, malt is formed.

Malt—a sweet mucilaginous substance, which is more easily digested, but weight for weight is rather less nutritive than barley—forms a palatable and digestible article of diet for sick or convalescent horses, and is used for making poultices and demulcent laxative drinks. Barley-water, infusions of malt, and soft mashes prove especially serviceable in febrile cases both in horses and cattle. **Malt extracts** are occasionally prescribed for dyspeptic calves, and when well prepared are rich in diastase, and hence useful in aiding digestion of starch.

When a solution of malt is fermented, as in the preparation of beer, ale, or porter, there rises to the surface of the liquor a yellow-brown frothy scum, known as **yeast** or **barm**, the Cerevisiæ fermentum of the B. P., readily putrefying when moist, but when carefully dried remaining for a long time unchanged, and owing its reproductive properties, and its characteristic power of converting cane into grape sugar, and thence into alcohol, to the presence of ovoid confervoid cells of Torula cerevisiæ. Yeast is occasionally used as a purgative, especially for cattle, and is given in quantities of about a pint. Antiseptic and deodorising poultices are made by stirring together one part each of boiling water and of yeast with two parts of bran or linseed meal, and allowing the mixture to stand near a fire until it rises, when it is fit for use.

BELLADONNA.

BELLADONNÆ FOLIA. Deadly Nightshade. The fresh leaves, with the branches to which they are attached, of Atropa Belladonna, also the leaves separated from the branches carefully dried, gathered when the fruit has begun to form from plants growing wild or cultivated in Britain. B. P.

Belladonnæ Radix. The root of Atropa Belladonna, growing wild or cultivated in Britain and carefully dried, or imported in a dry state from Germany. B. P. *Nat. Ord.*—Atropaceæ.

Belladonna grows wild in most parts of Great Britain, especially about old walls, edges of plantations, and ruinous shady places; but so great is the demand for its preparations, that it is now largely cultivated at Hitchin and elsewhere, and the cultivated are as active as the wild specimens. It has a fleshy, branching, perennial root, 12 to 18 inches long and 1 to 2 inches thick; a round, branched, reddish, downy, annual stem, 3 to 5 feet high; broadly ovate, acute, entire, smooth leaves, 3 to 8 inches long, alternate below, in pairs of unequal size above, supported on short leaf stalks of a sombre-green colour, and a faint bitter taste; pendulous dark-purple, bell-shaped flowers, appearing in June or July; a round violet, berried, mawkish-tasted fruit, the size of a small cherry, ripe in September, and containing numerous kidney-shaped seeds. The plant has greatest activity towards the end of June and throughout July, when flowering is over, but before the fruit and seeds are developed. It is cut down and speedily dried; and so liable is it to deterioration from heating and moulding, that it is advised immediately to make the medicinal preparations. When the young branches as well as the leaves are used, the preparations are found to keep better, and to be more uniform and active.

The active principle atropine ($C_{17} H_{23} N O_3$) is also the active principle of Datura stramonium, and is associated in belladonna with hyoscyamine, which is similar and isomeric with it, but is more largely present in henbane. Atropine occurs in the plant as a bimalate. The leaves contain 0·46 per cent., the younger roots as much as 0·60 per cent. It is prepared from a strong tincture, but can also be made synthetically by the action of hydrochloric acid on salts of tropin. It occurs in colourless acicular crystals, is volatile, has a bitter taste, is sparingly soluble in water, and more readily in alcohol and ether. The easily soluble sulphate is more frequently used than the alkaloid. It gives a citron-yellow precipitate with gold perchloride. An alcohol solution

of mercuric chloride added to a crystal or strong solution of atropine causes a precipitate which becomes red on standing or when boiled. Its most **distinctive test,** however, is its dilating the pupil.

ACTIONS AND USES.—Belladonna and atropine in poisonous doses paralyse the brain, medullary, and spinal centres, quicken circulation, cause delirium and irregular movements, and kill by asphyxia. Medicinal doses are antispasmodic and anodyne. They are used externally to relieve irritability and pain, and in examinations and diseases of the eye for dilating the pupil and relieving congestion and inflammation.

GENERAL EFFECTS.—Belladonna and atropine in full doses cause dryness of the mouth, **dilatation of the pupils,** a scarlatina-like rash on the skin, more noticeable in men than in the lower animals, **quickened pulse, delirium, with tendency to active irregular movements.** They stimulate the brain centres, but paralyse the ends of motor nerves, hence result the concurrence of delirium and constant movements with lassitude. They stimulate and then paralyse the spinal cord. Small doses stimulate, but large doses paralyse the centres in the medulla. The vaso-motor medullary centres, as well as the peripheral vaso-motor ganglia, and probably the muscular fibres of the arteries are stimulated by small doses, and blood-pressure is consequently raised, while temperature is increased. But large doses quickly produce paralysis. The manner of their action on the heart is not clearly determined. Dr Lauder Brunton believes that medicinal doses specially **stimulate the vagus and inhibitory ganglia.** Such doses, properly regulated, diminish the sensibility of the heart, and hence both belladonna and atropine are useful in most cases of palpitation. But large doses paralyse the terminals of the vagus both in the heart and lungs (Ringer.) The respiratory are acted upon much in the same way as the cardiac centres. Respiration is first quickened and then slowed, and slowing is almost immediately induced when the drug is subcutaneously injected. **Death** results chiefly **from paralysis of respiration.** Large doses paralyse involuntary muscles, but have no action on voluntary muscles. They notably **diminish the sensibility of sensory nerves** especially when applied topically, and hence result many of

their curative effects. By **paralysis of the special secreting ganglia** and nerves, they arrest secretion from the salivary, sweat, milk, and mucous glands, as well as from the liver and pancreas, and exert these effects whether they are swallowed or applied locally. Small doses increase while large doses diminish intestinal movements. **The iris is contracted** alike by local or internal administration of the drug (p. 56). The eye becomes bright, dry, injected, and the power of accommodation paralysed. Belladonna is quickly **eliminated by the kidneys**, mucous membranes, and skin.

Belladonna **resembles the other atropaceæ,** hyoscyamus and stramonium, but is more active. It is **allied to opium** in its antispasmodic and anodyne effects; but the distinctions between the two are marked and various. Full doses of belladonna or atropine paralyse the brain centres, but still more prominently the centres of the medulla and cord, and produce delirium, restlessness, and constant movements; while full doses of opium or morphine paralyse more particularly the brain centres and cause coma. Belladonna paralyses the vagus and inhibitory ganglia of the heart, and hence accelerates the pulse, while opium slows it. Atropine stimulates, while morphine depresses the respiratory centre. Atropine dilates, morphine contracts the pupil. The secondary effects of belladonna in paralysing the ends of motor nerves ally it to hemlock, which it also resembles in dilating the pupil and paralysing the ends of sensory nerves. The more notable **physiological antagonists** of belladonna are caffeine, Calabar bean prussic acid, and jaborandi. Methyl and ethyl atropine, although paralysing the ends of motor nerves and retaining the specific effects of atropine on the eye, heart, and respiratory centre, do not tetanise.

Toxic Effects.—**Horses** were experimented on by Hertwig. Upwards of twenty received four to six ounces of the dry pulverised herb given with meal and water, in four separate doses, at intervals varying from four to eight hours. In four or five hours, and still more on the succeeding day, he observed dulness, languor, uneasiness, dilated pupils, and a feverish mouth; appetite was gone, digestion impaired, gas abundantly evolved in the stomach and intestines. The pulse

numbered about 90, was small, hard, and scarcely perceptible; breathing was short, quick, and accompanied by flapping of the nostrils; sensibility was slightly diminished, but there was no drowsiness. Some of the cases exhibited much abdominal pain; others, imperfect power of moving the hind extremities; others terminated fatally in thirty to fifty hours after exhibition of the first dose; but in most the symptoms gradually retrograded, and after thirty-six or forty-eight hours the animals were perfectly well. Two to three ounces of the dried root acted on horses in a similar manner; and six ounces usually proved fatal (*Arzneimittellehre*).

With atropine sulphate subcutaneously injected, Dr John Harley and Messrs F. & J. Mavor, of Park Street, London, in 1867 made an extended series of experiments on a healthy six-year-old horse, and a weakly two-year-old thoroughbred. These experiments were detailed in *The Old Vegetable Neurotics* by Dr John Harley, published in 1869.

One-twelfth of a grain dissolved in water caused in about half an hour acceleration of the pulse from 32 to 42 beats; after another half-hour a further rise of ten beats had generally been reached. The tongue and mouth were dry, and the temperature increased. The pupils began dilating after thirty-five minutes, and reached their maximum in an hour, when the iris was scarcely visible. The symptoms gradually receded, and in two to three hours had disappeared.

One-sixth of a grain caused restlessness, and dryness of the mouth, and in thirty-five minutes an increase of 34 beats in the pulse, which was full, soft, and compressible, and only fell to its original number after six hours; the dilated pupils returned to their normal state after three hours; upon the secretions no effects were notable.

One-fourth of a grain, in twelve minutes, increased the pulsations from 38 to 56, producing also slight irregularity; the pupils gradually dilated, and in an hour reached their fullest expansion. These effects on the pulse and pupils, with dryness of the mouth and lips, continued unabated during three hours. For eighteen hours the animal remained dull and quiet.

Half a grain in twelve minutes fully dilated the pupils; the

pulse rose to 68; the mouth, tongue, and lips became dry; the horse gaped occasionally, and stood perfectly quiet; after three hours showed considerable nervousness, and was restless when disturbed; for six hours the pulse continued weak and compressible; but the effects gradually declined.

Two grains, also introduced subcutaneously, after fifteen minutes raised the pulse 35 beats, and rendered it weak; there was dryness of the mouth, yawning, restlessness, and nervousness. The animal was partially blind, misjudged distances, and appeared under the influence of illusions; the membranes of the eye were injected. Occasional hiccough, tremulousness, and twitching of the intercostal muscles and panuscorium continued for fourteen hours, when the symptoms generally declined; but the pupils remained dilated for twenty-four hours. Urine was frequently voided, and in rather increased amount; the mucous secretions of the bowels and the bile were slightly augmented; the skin secretions unaffected; the respiratory functions not disturbed.

These and other experiments of Dr Harley's, demonstrate that the maximum stimulation of the heart results from doses insufficient to produce nervous excitement. Medicinal doses quiet the cerebro-spinal nervous system, but over-doses cause undue sensibility to external impressions, wakefulness, and in extreme cases, delirium.

Cattle are stated by Hertwig to be as susceptible of the action of belladonna as horses. He records that two to four ounces of the root caused in cows violent symptoms lasting forty-eight hours, and that larger doses were dangerous.

Dogs receiving full doses of belladonna exhibit less marked cerebral, but **more pronounced and prolonged cardiac effects than horses.** This apparently depends upon the heart of dogs being more under the regulating influence of the vagi and inhibitory ganglia which the drug specially paralyses. Dr John Harley found that while half-a-grain of atropine sulphate doubled the pulsations in horses, a quarter of a grain trebled them in dogs. Doses of one ninety-sixth to one-fourth of a grain raised the dog's pulse in a few minutes from 120 to 400, the beats continuing strong and regular; the pupils were so fully dilated that vision was imperfect, owing to the want of

the regulation power of the iris; the mouth and nose were dry and hot. The larger doses further caused slowness and unsteadiness of movement, but no loss of sense or intelligence.

A Scotch terrier, 16 lbs. weight, received $\frac{1}{80}$ grain atropine sulphate injected under the skin of the back; in four minutes the pulse rose from 118 to 280; the respirations advanced from 19 to 30; the pupils were dilated to their full extent, the mucous membranes were dry, the animal excited and whining; the effects continued four hours. Dogs 15 lbs. and 16 lbs. weight were killed in three hours by three-quarters of a grain, with symptoms of prostration, the pulse rapid and feeble, respiration irregular and shallow, muscular twitchings, the sphincters paralysed, death occurring in convulsions.—(*The Old Vegetable Neurotics.*)

Hertwig found that 30 to 50 grains of the dried herb or root given to dogs in thirty minutes contracted the iris, so that it was out of view, and rendered the eye insensible to bright light. Vomiting sometimes occurred, the nose became dry and hot, and the gait tottering from inability to move the hind extremities. In one to three hours the symptoms began to abate, but contraction and diminished irritability of the iris remained even after twenty-four hours. Orfila poisoned dogs with 15 grains of extract. Professor Christison recorded that half an ounce of the watery extract killed dogs in about thirty hours when given by the mouth, half that quantity in twenty-four hours when introduced into a wound; while even smaller doses are more speedily fatal when injected into the jugular vein.—(*On Poisons.*)

Rodents, such as rabbits, guinea-pigs, and rats, as well as **pigeons,** do not exhibit the marked acceleration of the pulse-rate so remarkable in dogs and cats, for the vagus in rodents and birds exerts much less regulating effect on the heart. Rabbits require 15 grains of green extract to poison them, pigeons 2 grains.

The post-mortem appearances are those of asphyxia. The blood is dark-coloured, and coagulates slowly, the ventricles are generally empty and firmly contracted.

The antidotes consist in the administration of alcohol, ammonia, or other diffusible stimulants, in order to antagonise

the general paresis. Subcutaneous injection of caffeine is enjoined in human patients, with the cautious use of physostigma, and artificial respiration if necessary. Stupor, if impending, is combated by moving the animal about, or by the galvanic battery.

MEDICINAL USES.—In virtue of their stimulating the respiratory centre, abating excessive mucous secretion, combating spasms of involuntaty muscles and **soothing irritability,** belladonna and atropine are serviceable in catarrh, pharyngitis, laryngitis, and bronchitis in all patients, and are used in the several forms of inhalation, spray, electuary, and hypodermic injection. In influenza in horses, they besides beneficially **stimulate the weakened heart.** Professor Robertson prescribed belladonna with small doses of aconite in the acute stages of respiratory diseases in horses; but it is chiefly serviceable in the second stages when secretion is over-abundant, swallowing difficult, and the throat irritable.

The noisy respiration accompanying some cases of epizootic sore throat, and the loud prolonged spasmodic cough of laryngitis are usually relieved by its use. Along with ether or ammonium carbonate, belladonna abates the distressed breathing and cough occuring in bronchitis, as well as in distemper in dogs.

Paralysing involuntary muscles belladonna and atropine control **palpitation,** especially when depending upon cardiac strain, and in such cases are given internally, while belladonna plaster is used externally. The late Professor Robertson was wont to prescribe in **spasmodic colic** in horses half a drachm of belladonna extract in four ounces of liquor ammoniæ acetatis, sometimes adding four to six minims of Fleming's tincture of aconite. In cases of colic which have defied other remedies, as well as in enteritis, belladonna is conjoined with opium, and is stated to be specially indicated when the glandular structures of the bowels are implicated (*Equine Medicine.*) No antispasmodic and anodyne is more effectual in such cases than **atropine and morphine used hypodermically.** In obstinate constipation and obstruction of the bowels, small doses of belladonna ward off griping, favour peristalsis, and aid the action of laxatives.

Belladonna is the remedy most to be relied on in **tetanus** in horses. As soon as a dose of physic is given, Professor Williams

begins its administration, and continues with small doses, also applying it locally to any wound. Professor Robertson regarded it as the best anodyne in tetanus, and prescribed ʒi. to ʒiij. of extract placed within the teeth several times a day. Along with the constitutional treatment, other practitioners rub in the liniment down each side of the spine. In cerebro-spinal meningitis, Professor Williams prescribes belladonna or atropine, sometimes conjoined with ergotin and the use of the spinal ice bag; while Professor Robertson, after applying rugs wrung out of hot water along the spine, applied belladonna plaster. Neither the crude drug nor the alkaloid effect permanent benefit in hydrophobia, epilepsy, or chorea.

Whether prescribed internally or as an injection, they allay **irritation of the urinary bladder, rectum, and uterus.** The extract is sometimes applied to the neck of the uterus when it is rigid and unyielding, in cases of delayed parturition. In **mammitis** it beneficially checks secretion of milk, and paralysing nerve endings, allays congestion and inflammation. For such purposes it is used both generally and locally, and the hypodermic injection of atropine is specially serviceable. In virtue of its stimulation of the heart, belladonna and atropine are antidotes for poisoning by opium, Calabar bean, pilocarpine, and chloroform.

In examinations and diseases of the eye atropine sulphate is used locally for dilating the pupil, and assisting in the detection of cataract and testing the condition of the refracting media. For such purposes a solution of $\frac{1}{20}$ grain to the ounce of water is used, and is sometimes conjoined with cocaine. It prevents prolapse of the iris, or restores it to its normal position in lesions of the cornea, or in perforating ulcer which is frequent in dogs. In **iritis** it relieves congestion, and prevents or breaks down adhesions between the iris and the capsule of the lens, in such cases being sometimes alternated with myotics. It must be avoided in cases where there is increased tension in the globe of the eye.

External topical applications often determine and increase the effects produced by internal administration, as exemplified in the belladonna plaster applied to the spine in tetanus, the loins in irritation of the kidneys or bladder, or over the chest

in palpitation. Belladonna or atropine reduces congestion, irritability and pain in **wounds, glandular swellings,** injuries of the œsophagus, in **rheumatism,** and in those over-sensitive conditions of the skin and muscles which sometimes occur in horses and hounds from severe exertion. For removal of rheumatic and neuralgic pains, it is usually conjoined with opium or chloral, sometimes with aconite, and is frequently used hypodermically.

DOSES, ETC.—Of the dried powdered leaves horses and cattle take about ℥ij.; dogs, grs. v. to grs. x. The plant is seldom, however, used in the crude form, but is made into extracts, succus, or tincture. Exposure to elevated temperature or long keeping often spoils belladonna preparations. An active, well-keeping **green extract** is made by the B.P. process, by which 100 lbs. of trimmed leaves and young branches yield nearly 6 lbs. to 7 lbs. of green extract (p. 141.) The dose for horses is ʒi. to ʒij.; for cattle, ʒij. to ʒiij.; for sheep, grs. x. to grs. xx.; for dogs, grs. i. to grs. iij. In catarrhal and influenza cases the extract is frequently prescribed with alcohol, ether, or camphor. A convenient **electuary** is made with liquor ammoniæ acetatis and treacle. Professor Robertson used a belladonna and camphor electuary made with powdered myrrh, nitre, powdered liquorice root, and treacle. An **alcoholic extract,** made by maceration and percolation with rectified spirit, is about four times the strength of the ordinary extract.

The **succus** (p. 142) is got by bruising the fresh leaves and branches in a stone mortar, pressing out the juice, and adding to it one-third of spirit. An ounce is the dose for the larger animals, ♏v. to ♏xx. for the smaller. The **tincture,** made by maceration and subsequent percolation of one ounce of belladonna leaves with a pint of proof spirit, is given in similar doses.

For **external** application the **linimentum belladonnæ** is prepared with 20 ounces of the root in No. 40 powder, and sufficient rectified spirit to make 30 ounces, treated in the same manner as in the preparation of the tincture, and allowed to pass into a receiver containing one ounce of camphor. Veterinarians frequently extemporise an ointment by melting by the heat of a water-bath one part of extract and four of vaselin,

adding, as the mixture cools, half a part of camphor. Mr Squire has introduced a soothing and readily-absorbed liniment, made by mixing with the tincture one-seventh part of chloroform. **Belladonna plaster** is made by melting by the heat of a water-bath two parts each of resin and soap plasters, adding one of the alcoholic extract, and mixing thoroughly.

Atropine, being sparingly soluble in water, the sulphate is generally used. It is more than one hundred times the strength of the green extract. The B. P. **liquor atropinæ sulphatis** consists of one part of atropine sulphate and 99 of camphor water, and contains 4 grains in one fluid ounce. For horses and cattle the dose is f℥i. to f℥iij,; for dogs, ♏i. to ♏iij. One-fifth of these doses suffice when used hypodermically, and even smaller doses had better first be tried. As already stated, specially prompt and marked antispasmodic and anodyne effects are secured by conjoining about equal proportions of atropine and morphine solutions. For examinations and diseases of the eye, the solution of atropine sulphate is employed. For ophthalmic and other purposes, tissue papers containing $\frac{1}{250}$, and lammellæ of gelatin containing $\frac{1}{5000}$ grain are convenient. An **ointment** is occasionally used, one part atropine being dissolved in $3\frac{1}{2}$ parts rectified spirit and 55 parts benzoated lard.

BENZOIN.

BENZOINUM. GUM BENJAMIN. A balsamic resin obtained from Styrax Benzoin, and probably from one or more other species of Styrax. It is generally procured by making incisions into the bark of the trees and allowing the liquid that exudes to concrete by exposure to the air. (B.P.) *Nat. Ord.*—Styracaceæ.

The Styrax Benzoin abounds in Siam, Sumatra, and Borneo. When six years old it reaches the thickness of a man's body, and, for ten years, each tree annually yields about 3 lbs. of resin. Incisions are made through the bark, when the thick white resinous juice exudes, and concretes in tears, which are subsequently made into larger masses, and imported in wooden cases. Two sorts occur in the drug stores, the Siam and the

Sumatra, the first being most esteemed. The first three or four years' yield of the trees is also paler, more translucent, and of finer quality. The colourless or reddish tears are imbedded in an amber-brown transparent resin. Inferior qualities are dark brown or nearly black, and devoid of amygdaloid structure. Benzoin is brittle and easily pulverised, slightly heavier than water, of a faint sweet taste, and an agreeable balsamic odour, much increased when the masses are rubbed or burned. It is dissolved by alcohol, alkalies, and acids, but imperfectly by water.

Besides traces of volatile oil, benzoin contains about 80 per cent. of three **resins** distinguished by differences of solubility, and from 14 to 20 of **benzoic acid** ($HC_7 H_5 O_2$),—an acrid, crystalline acid, prepared by dry distillation of benzoin, or by boiling it with lime and decomposing the calcium benzoate. The acid is now also prepared from naphthalin ($C_{10} H_8$), and also from hippuric acid obtained from the urine of herbivora (p. 271). Some samples of benzoin contain as much as 10 per cent. of the allied cinnamic acid ($HC_9 H_7 O_2$).

Actions and Uses.—Benzoin is a mild stimulant, expectorant, and antiseptic. It is allied to such balsams as storax, and balsams of Peru and Tolu. It was formerly in high repute as a remedy for coughs, pectoral complaints, and consumption; it diminishes bronchial secretion; it is excreted mainly in the urine, part of the benzoic acid being converted in the kidneys into hippuric acid. If given internally horses and cattle take half-an-ounce, dogs two to ten grains. It was used as a **vulnerary** long before carbolic, salicylic, or boric acids were known. Freely applied to recent bleeding wounds, an odorous antiseptic coagulum is formed, superficial bleeding vessels are closed, and when tow or cotton-wool, well wetted with the antiseptic solution, is strapped on with some Mackintosh covering, recent wounds may be thus maintained aseptic.

Benzoin is chiefly used in the form of **Friar's Balsam,** or its pharmaceutical imitation, **the compound tincture,** which is thus prepared:—Take of benzoin, in coarse powder, two ounces; prepared storax, one and a half ounce; balsam of Tolu, half an ounce; Socotrine aloes, 160 grains; rectified spirit, 17 fluid ounces. Macerate for seven days with

occasional agitation, then filter, and add sufficient rectified spirit to make one pint. (B.P.) This tincture is extensively used both professionally and popularly, as a **stimulant and antiseptic** for wounds, ulcers, and various skin complaints in all classes of patients. **Benzoated lard** is made with 10 grains benzoin to each ounce of lard.

Styrax or storax, a balsam from the inner bark of Liquid ambar orientalis, contains styrol, cinnamic acid, styracin, and resin, and is a stimulant, expectorant, antiseptic, and parasiticide.

Balsam of Peru is obtained from the Myroxylon Pereiræ, a papilionacious leguminosæ, contains resin, volatile oil, benzoic, and cinnamic acids, and has the same actions as styrax.

Balsam of Tolu is yielded by the Myroxylon Toluifera, contains a resin and volatile oil, and is occasionally used as a stimulant expectorant.

BENZOL OR BENZENE SERIES OF AROMATIC CARBON COMPOUNDS.

The benzol, benzene, or aromatic series of carbon compounds includes a number of **antiseptics** and **febrifuges.** The lowest members of this series contain six carbon atoms, five of which have their affinities satisfied by hydrogen, constituting the organic radicle phenyl ($C_6 H_5$). The hydride is benzene ($C_6 H_5 H$.). Substitution of hydroxyl (OH.) for the separate hydrogen atom produces the alcohol—carbolic acid ($C_6 H_5 OH)_5$. A like substitution of one or more of the hydrogen atoms for other organic radicles, forms other aromatic bodies. Further variety of constitution is determined according to which of the six atoms of carbon in the so-called carbon ring, assume the hydroxyl or other radicle. Still further variety appears to result from fusion of molecules of the same or of different members of the group; two benzene molecules appear to form naphthalin ($C_{10} H_8$); a benzene and pyridine molecule chinolin ($C_9 H_7$) which is allied to quinine; indeed it is generally believed that many of the organic alkaloids are

closely related to this aromatic series—(*Dr Lauder Brunton.*) By slight re-arrangement of the atoms of these bodies, and by substitution of various radicles, other valuable artificial substances will doubtless be obtained.

The higher members of the pyridine series are specially active. These actions form a striking contrast to those of the fatty series of carbon compounds of the marsh-gas group (CH_4)—the hydrides of which are stimulant and anæsthetic, while their effects are exerted on the sensory rather than on the motor centres.

The following are some of the more important of this benzol phenyl or aromatic group, most of which are noticed now, but carbolic and salicylic acids and creasote will receive consideration later, under their alphabetical headings.

Benzol or benzene	$C_6 H_5. H$
Phenol or carbolic acid (*sse after*)	$C_6 H_5. O H.$
Creasote (*see after*)	
Nitro-benzene	$C_6 H_5. NO_2$
Benzoic acid	$C_6 H_5. CO. OH.$
Resorcin	$C_6 H_4 (OH)_2$
Hydroquinone	$C_6 H_4 (OH)_2$
Pyrocatechin	$C_6 H_4 (OH)_2$
Pyrogallic acid	$C_6 H_3 (OH)_3$
Salicylic acid (*see after*)	$HC_7 H_5 O_3$
Naphthalin	$C_{10} H_8$
Naphthol	$C_{10} H_7 (OH)$
Pyridine	$C_5 H_5 N.$
Kairin	$C_{10} H_{13} NO$
Antipyrin	$C_{11} H_{12} N_2O.$
Thallin	
Antifebrin	$C_6 H_5. C_2H_3O. NH.$

Benzol or Benzene derived its name from its being originally prepared by distilling benzoic acid and slaked lime, but it is now chiefly obtained from the fractional distillation of coal tar. It is an ethereal inflammable liquid with the odour of coal-gas, and the specific gravity ·878. It is insoluble in water, but soluble in alcohol and ether, and a useful solvent for fats, resins, and caoutchouc. Benzene is a

perfectly distinct body **from benzin,** petroleum benzin, or petroleum ether, which is a purified distillate obtained from American petroleum—a paraffin of the marsh gas series, consisting chiefly of $C_5 H_{12}$, and sometimes used as an anæsthetic anthelmintic and parasiticide. Coal-tar benzene is an **antiseptic** and **sedative,** and is used for the destruction of skin-parasites, for allaying irritation in prurigo, urticaria, and other skin diseases, and as a solvent of fats and resins.

NITRO-BENZENE is prepared by dropping benzene into strong nitric acid. When purified by washing it is a heavy oily liquid, with an odour of almonds. It is used in the preparation of aniline dye.

BENZOIC-ACID (p. 268) occurs in light feathery crystalline plates or needles, which have an agreeable benzoic odour, are sparingly soluble in water, but readily in rectified spirit or solution of caustic alkalies. It is **stimulant, antiseptic,** and **expectorant.** It is as effectual as carbolic acid in arresting the action of enzymes and destroying bacteria. Professor Rutherford found that 20 grs. increased the biliary secretion of dogs. It is eliminated from the kidneys, in which it unites with glycocoll, is excreted as hippuric acid, increasing the quantity and acidity of the urine. Ammonium benzoate is sometimes used, and sodium benzoate is prescribed as an antiseptic in diarrhœa in young animals.

RESORCIN is obtained by the distillation of galbanum, ammoniacum, asafœtida, or other such gum resins, or extract of Brazil wood, with potash, and occurs in white crystalline plates, has a harsh sweet taste, and is freely soluble in water and oils. It is **a powerful antiseptic,** used in diphtheritic and ulcerated sore throat. It coagulates albumin ; saturated solutions cauterise the skin. Administered to frogs it acts like carbolic acid ; on dogs and rabbits it causes perspiration, chronic convulsions, dyspnœa, and death from paralysis. In man, 30 grs. produce giddiness and intoxication like that of alcohol. Its antipyretic action is not of long duration.

HYDROQUINONE is chemically para-di-hydroxy-benzene, resembles resorcin, but is about four times stronger. As it is excreted in the urine it exerts a stimulant and antiseptic action on the urino-genital mucous membrane (p. 278).

PYROCATECHIN, or ortho-di-hydroxy-benzene, resembles resorcin in its actions and uses, but is about three times stronger.

PYROGALLIC ACID, or tri-hydroxy-benzene, is obtained by heating gallic acid, and is readily soluble in water and alcohol It is more irritant than most of the series, but is a doubtful antiseptic. A few grains produce in dogs, as well as in man, vomiting, purging, and collapse. It decomposes the red corpuscles. Mixed with fatty matters or starch, it is sometimes used as a caustic. A 15 per cent. ointment has been applied with good effect in psoriasis.

NAPHTHALIN is prepared from tar, and occurs in colourless, soft, peculiar-smelling crystals. Owing to its insolubility in water, dilute acids and alkalies, it has been used as an **internal antiseptic.** It deprives the fæces of odour throughout the whole length of the canal, and is useful in diarrhœa and dysentery, being prescribed either alone or with castor oil. As it is in part excreted in the urine, it exerts similar antiseptic effects in diseases of the bladder.

NAPHTHOL of several varieties is got from tar. The beta variety is chiefly used, and is an effectual **germicide** applied in alcoholic solution in the treatment of mange and also of eczema.

PYRIDINE is obtained from the destructive distillation of bones and amylnitrate. It is the typical member of a series of alkali-like bases found in coal tar. It is a colourless, strong-smelling, volatile liquid. It is stated to diminish the reflex activity of the spinal cord and respiratory centre.

KAIRIN is a powerful diaphoretic and antipyretic, is reported to retard oxidation, and in human patients 4 to 8 grs. are used repeated every hour.

ANTIPYRIN, as commercially prepared, is chemically diethyl-oxy-chinicine. It is a synthetically prepared alkaloid, occurring as a white powder, soluble in water, with a bitter sweet taste. It **lowers temperature** when given to men, dogs, and rabbits, in doses of 15 to 30 grs. The effects are observable within half-an-hour, and continue about two hours. It slightly increases blood-pressure, causes perspiration, and is excreted in the urine.

THALLIN is a synthetically prepared alkaloid, chemically

known as tetra-hydro-para-methyl-oxy-chinolin. It is a colourless powder with a taste and smell resembling meadow-sweet. It is a powerful antipyretic given in about the same dose as antifebrin, but is not so effectual (*Brunton*).

ANTIFIBRIN, or phenyl-acet-amide, is prepared by the action of glacial acetic acid on anilin. It is a white crystalline neutral odourless powder, producing a slight burning sensation on the tongue; not very soluble in water, but readily dissolved in alcohol and ether. It appears to be **the most reliable of these aromatic antiseptic antipyretics.** It is stated to be a cerebro and vaso-motor stimulant, devoid of the somewhat depressing after-effects which characterise antipyrin, with less diaphoretic but more notable diuretic effect. Its febrifuge action is more lasting, and is produced by less than half the dose of antipyrin. Dogs and guinea-pigs take considerable doses without injury—(*Dr Lauder Brunton*). Mr J. A. Nunn of the Army Veterinary Department has prescribed it in Natal in several of the continued fevers which affect animals in that country, especially during autumn; has given cattle drachm doses, and dogs five grains, dissolved in ether, repeated every four hours, and reports marked lowering of temperature, unaccompanied by nausea or other untoward effects (*Veterinary Journal*, August 1888).

BISMUTH AND ITS SALTS.

The soluble salts of bismuth, such as the citrate of bismuth and ammonia, in large doses resemble salts of antimony and arsenic, and cause gastro-enteritis and fatty degeneration of the liver. Small doses of such sparingly soluble salts as the sub-nitrate ($Bi\,O\,NO_3.\,H_2\,O$) **allay irritation in dyspepsia,** vomiting, and gastro-intestinal catarrh, probably in virtue of mechanical action anaolgous to that of charcoal or manganese binoxide. It is also used in combination with starch, boric, or salicylic acids to relieve irritability of abraded itching conditions of the skin (*Brunton*). If given to horses, the dose of the sub-nitrate is ʒi. to ʒii.; for dogs, grs. iii. to grs. x. are prescribed.

BORIC ACID.

ACIDUM BORICUM—BORIC ANHYDRIDE. Boric or Boracic Acid, $H_3 BO_3$.

Boric acid is obtained from sodium biborate by the action of sulphuric acid. In volcanic parts of Italy and in the Lipari Islands, through natural fissures or holes bored in the earth, there issue vapours and jets of steam, which are passed through water, and the solution subsequently evaporated, yields colourless pearly lamellar crystals of boric acid. They are feebly acid, and bitter, with a sweetish after-taste, and dissolve in 25 parts of cold water, in 3 of boiling water, in 10 of rectified spirit, and 5 of glycerin, and communicate a green colour to an alcohol flame. Aiding the fusion of other bodies, it is much used as a blow-pipe test; mixed with 7 parts of acid or potassium tartrate, it constitutes the soluble cream-of-tartar of the shops. When heated, the three molecules of water of crystallisation are driven off, and anhydrous vitreous boric acid remains ($B_2 O_3$).

ACTIONS AND USES.—Boric acid is a non-volatile, unirritating antiseptic. It is occasionally prescribed internally. I have given it with benefit in diarrhœa in foals and calves, with diluted spirit or ether. It is excreted in the urine, and hence exerts its antiseptic effects in cystic catarrh.

As an **antiseptic** it is about the same strength as carbolic acid. Koch found that one part in 1250 of water hindered, and one part in 800 prevented, development of anthrax bacillus. The carcase of a horse, which had lain four months in a Calefornian soil rich in borax, was completely preserved and free from odour (Robottom). Being non-poisonous, it has been used for the preservation of milk, fish, and other articles of food. Unlike carbolic acid, it is not volatile, and hence its effects, like those of borax and salicylic acid, are confined to the parts with which it comes into actual contact. Even in concentrated form, it is not so irritant and caustic as carbolic acid, and hence is adapted for wounds, which for some time have been treated with carbolic acid, and in which granulation has become tardy. A foul wound or ulcer of moderate size,

after being thoroughly washed with corrosive sublimate or zinc chloride, or repeatedly dressed with carbolic acid, may usually be kept in an aseptic state by boric acid. In the form of **lotion** or **ointment,** it proves a soothing dressing for burns and blistered surfaces; as a spray, it relieves aphthous irritable ulcerated throats, and, like borax, checks excessive salivary or pharyngeal secretion. Alternated with weak alkaline lotions or zinc oxide dressings, boric acid, conveniently mixed with six or eight parts of starch, abates the erythema and itching of the inflammatory and weeping stages of eczema rubrum in dogs; and is equally useful in similar eczematous conditions in horses. Both catarrhal and purulent conjunctivitis are benefited by wetting the irritable surfaces three or four times daily with solutions of three to six grains to the ounce of water, alternated with atropine lotions.

DOSES, ETC.—Horses and cattle take ʒiii. to ʒvi.; foals and calves, grs. xx. to grs. xxx.; dogs, to which it is usefully given in distemper, grs. v. to grs. xx.

A saturated **solution** is made with one part of acid to twenty-six of water, and, for surgical purposes, is used diluted as required. A few grains of salicylic acid are sometimes added. An **ointment** is prepared by melting four parts soft paraffin and two of hard paraffin, and adding one part boric acid in fine powder. **Boric lint** is made by soaking lint, cotton wool, or oakum in a saturated boiling watery solution, from which the acid crystallises, adhering to the fibrous material. Like carbolic lint, eight or ten folds are applied, either wet or dry, over the wound; being unirritating, no protection is needed; in order to prevent evaporation and access of ubiquitous micro-organisms, a piece of mackintosh is laid on with the oiled surface inwards; unless the discharges are excessive, an ample and properly applied dressing does not require to be disturbed for several days. A few folds of lint applied wet to a wound or ulcer, and covered with oiled silk or mackintosh, acts as an antiseptic poultice, and its effects may be kept up by pouring the lotion from time to time between the folds of lint.

Boro-glyceride is made by heating 92 parts of glycerin with 62 of boric acid. A solution of 1 to 40 of water,

diluted as required, is used as an antiseptic gargle, a lotion for purulent ophthalmia, and a dressing for wounds.

BROMINE AND BROMIDES.

Bromine is a non-metallic liquid element (Br) obtained from sea-water. It is dark red-brown, and volatile; has a strong, disagreeable odour and taste, and produces a yellow colour when added to cold starch water. It is a **powerful irritant,** is occasionally used as a **caustic, deodoriser,** and **disinfectant.** Its several salts and hydro-bromic acid are devoid of irritant action, and are preferred to the element itself for medicinal use.

POTASSIUM BROMIDE (K Br.) is prepared by heating bromine and caustic potash with charcoal. It occurs in colourless, cubical, odourless crystals, which have a pungent saline taste, and are freely soluble in water. Large doses **impair the reflex functions** of the spinal cord and brain. Given to dogs for several weeks, until they are brought thoroughly under its influence, the gait becomes tottering and unsteady, the muscles weak, and there is drowsiness and insensibility to outward impressions, while irritation of the cortical substance of the brain fails to produce epileptic convulsions (*Brunton*). It is **used** chiefly in **nervous disorders** to allay excitement, relieve spasm, and produce sleep. Professor Robertson recommended both bromine and bromides in sclerosis of the spinal cord conjoined, or alternated with iodine, iron, arsenic, and nux vomica. In dogs, potassium bromide alleviates and wards off epileptic convulsions, whether connected with distemper or other causes. It often checks persistent vomiting, is useful in asthma and chorea, and has considerable anaphrodisiac effect. It has no constant or decided influence in controlling the spasms of tetanus in horses.

Bromides of **sodium** (Na Br.) and **ammonium** (NH_4 Br.) resemble bromide of potassium, but are believed to be rather less apt to cause gastric irritation or after-depression. In human practice these bromides are used conjointly in the proportion of one part each of bromides of potassium and sodium, and half a part of bromide of ammonium. Bromides of calcium

(Ca Br_2) and lithium (Li B_2) do not materially differ from those mentioned. Bromide of zinc (Zn Br_2) has been introduced especially for epileptic cases, in the belief that it conjoins the actions of bromine and of zinc.

Of the bromides horses take ʒi to ʒij.; dogs, grs. v. to grs. xx., given in bolus or watery solution.

BROOM.

The fresh and dried tops of Cytisus scoparius. From indigenous plants. *Nat. Ord.*—Leguminosæ.

The tops and other parts of the shrub contain a neutral body scoparin (C_{21} H_{22} O_{10}) which has marked diuretic properties, and a volatile poisonous alkaloid sparteine (C_{15} H_{26} N_2), which is identical in its actions with coniïne. The plant is **diuretic** and **cathartic,** and the decoction and succus are prescribed in dropsy, especially connected with chronic renal and heart disease; in the latter cases being used or alternated with digitalis. Owing to its liability to cause irritation, broom is, however, objectionable in acute renal and other inflammatory dropsies. The succus—the most uniform and stable preparation—is given as a diuretic to horses, in doses of f℥j.; to dogs, ♏xx. to ♏xxx.

BUCHU.

Buchu Folia. The dried leaves of Barosma betulina, B crenulata, and B serratifolia. B. P. *Nat. Ord.*—Rutaceæ.

Buchu is a shrub two to four feet high, and a native of the Cape of Good Hope. The leaves are smooth, dull yellow-green, with a strong penetrating odour, a bitter aromatic taste, and varying in different species from half an inch to an inch and a half in length. They contain a volatile oil and a bitter substance.

Actions and Uses.—Buchu is a **mild tonic, diuretic,** and **diaphoretic**; but its special value is as a stimulant and astringent of the irritable, catarrhal, urino-genital mucous membrane. The late Professor Robertson gave it to allay

irritability in cystitis, using it either alone or along with borax or benzoic acid.

The dose of the leaves for horses or cattle is ℥i. to ℥iv.; for dogs, grs. x. to grs. xxx., infused in a covered vessel with 20 parts water for half an hour. Animals readily take this infusion when it is mixed with linseed-tea or barley-water. It is sometimes advantageously conjoined with belladonna, opium, hyoscyamus or potassium bromide.

Bearberry leaves—the leaves of Arctostaphylos Uva-ursi—contain the bitter neutral extractive **arbutin,** which within the body is in part converted into hydroquinone (p. 271), and acts as a stimulant and antiseptic in chronic vesical irritation.

The root of **Pareira brava** is also used for the same purposes as buchu and uva-ursi.

The **root** of **Collinsonia Canadensis**—stone or knob root—has been largely used in America as a remedy in inflammation of the urino-genital mucous membrane, alike in men and animals; and Dr T. Oliver, Newcastle-on-Tyne, with 15 grs. of extract, repeated thrice daily, gradually reduced the pus in several cases of cystitis in man, which had defied all other treatment (*Lancet*, 5th May 1888).

BUCKTHORNS.

The recently-expressed juice of the ripe berries of Rhamnus catharticus, or purging buckthorn.

The dried bark of Rhamnus Frangula or Black Alder. Collected from the young trunk and moderate-sized branches, and kept at least one year before being used. B. P.

The dried bark of Rhamnus Purshianus or Cascara Sagrada. B. P. *Nat. Ord.*—Rhamnaceæ.

The buckthorns are shrubby spinous trees, eight or ten feet high. The berried fruit and barks contain resinoid matters, with malic and tannic acids.

The berries of the R. catharticus are about the size of black currants, contain an acrid, nauseous bitter juice, which is evaporated, strained, and gently heated with sugar, ginger, and pimento, forming a **mild cathartic syrup,** of which dogs take

f℥i. to f℥ij.; and cats, fʒiv. to f℥i. A little senna confection jalap or castor oil renders this syrup more prompt and certain.

The bark of R. Frangula, when fresh, acts as a gastro-intestinal irritant; but when dried and kept for twelve months, oxidisation of the resinoid active matters appears to occur, and the fluid extract and decoction prepared from the bark are used in human practice as **laxatives.**

The R. Purshiani cortex or sacred bark, brought from the North Pacific coast, is generally used in the form of liquid extract, and by American practitioners is occasionally prescribed for dogs as a stomachic **bitter and tonic,** in doses of ♏v. to ♏x., and as a **laxative** in doses of about fʒi. These fluid extracts of buckthorn bark resemble rhubarb in actions and uses.

CAFFEINE.

An alkaloid usually obtained from the dry leaves of Camellia Thea, or the dried seeds of Coffea arabica, by evaporating aqueous infusions, from which astringent and colouring matters have been removed. B. P. $C_7 H_8 N_4 O_2$.

Caffeine and theine are now considered **identical,** and the same alkaloid is also got from the leaves of the Guarana or Paullinia, the Ilex paraguayensis, as well as from the Kola seeds. It is **homologous with theobromine,** which is obtained from the nibs of the Theobroma Cacao, and chemically is methyl-theobromine ($C_8 H_{10} N_4 O_2$). It occurs in colourless, inodorous, acicular crystals, sparingly soluble in cold water, more so in boiling water, and very soluble in chloroform. Treated with a crystal of potassium chlorate, and a few drops of hydrochloric acid, and the mixture evaporated to dryness in a porcelain dish, a reddish residue results, which becomes purple when moistened with ammonia.

Actions and Uses.—Caffeine **stimulates and subsequently paralyses** the **nerve centres** of the cerebrum cord and medulla. In dogs, cats, rabbits, and rats, full doses, hypodermically injected, exalt reflex excitability, and cause muscular rigidity, convulsions, and tetanus (Phillips). Large doses swallowed develop gastro-intestinal irritation.

Like theobromine, it exerts a **restorative effect on** both voluntary and involuntary **muscles,** enabling them to perform increased work. On account of its stimulating the medulla and cardiac centres, moderate doses **increase respiration** and **pulse rate,** and raise blood-pressure, and hence are serviceable **antidotes** in poisoning by belladona and atropine, as well as by opium and morphine. It is excreted in the urine, increasing alike the amount of the urinary solids and fluids, and is prescribed in human patients in cardiac and renal dropsy. Tea, well diluted with milk, is sometimes serviceable for horses, and still more so for foals, calves, and dogs reduced by acute disease or diarrhœa.

DOSES, ETC.—For horses, grs. x.; for dogs, grs. i. Half these doses are given hypodermically, and for such purposes the comparatively insoluble caffeine is conveniently dissolved in sodium benzoate or salicylate.

CALABAR BEAN.

PHYSOSTIGMATIS SEMEN. The dried seed of Physostigma venenosum. B. P. *Nat. Ord.*—Leguminosæ.

The Ordeal Plant of Western Africa is suffruticose and twining, with a stem often fifty feet long, a hooded stigma, and a legume in which lie two or three hard, brittle, shining claret-coloured seeds, about the size of ordinary beans. Their activity depends upon the presence of two alkaloids. (1) **Physostigmine** or eserine (C_{15} H_{21} N_3 O_2), occurring in colourless or pinkish crystals, soluble in alcohol, benzol, chloroform, and dilute acids, and partially in water; and paralysing nerve centres and stimulating muscular fibre; (2) **Calabarine,** soluble in water and alcohol, but not in ether; and causing strychnine-like convulsions.

ACTIONS AND USES.—Calabar bean stimulates voluntary and involuntary muscular fibres and paralyses nerve centres. Tetanic convulsions, such as those caused by strychnine, sometimes occur, depending on the presence of calabarine. As a paralyser and anodyne pure physostigmine should be employed, and is serviceable in overcoming intestinal obstruction, deserves further trial in tetanus, and is used in opthalmic cases

General Actions.—Full doses of the bean produce tetanic contractions of the hollow organs—the intestines, spleen, bladder, and uterus, and arrest secretion. **Small doses increase the excitability both of voluntary and involuntary muscles,** cause their contraction with less than the normal stimulus, but do not add to their working power. Small doses moreover **increase secretion** alike of saliva, sweat and mucus, probably by stimulation of secreting cells (*Brunton*). Poisonous doses paralyse the spinal cord; the posterior column is affected earlier and more fully than the anterior. Hence result the characteristic curare-like paralysis affecting motor and reflex functions, and which, involving the medulla, **kills by respiratory** arrest. The brain appears to be irritated, for cats and guinea-pigs poisoned by it exhibit great cerebral excitement, becoming timid and running wildly about. If administered to animals rendered epileptic by section of the sciatic nerve, or to human epileptics, it increases the number and severity of the fits (*Brunton*). Respiration is temporarily quickened, probably owing to stimulation of the vagi in the lungs, but is subsequently slowed from paralysis of the medullary respiratory centre. Full doses raise blood pressure and slow the pulse. It is excreted mainly by the bile, saliva and gastric secretions, but has not been found in the liver (*Professor Fraser*).

Physostigmine, in virtue of its promptly and effectually **relaxing the muscular fibres of the intestines,** is of practical value in the treatment of intestinal obstruction and obstinate constipation. This was first pointed out by Dieckerhoff of Berlin, and has recently been more fully demonstrated by Professor Fred. Smith and Assistant Professor Charles Rutherford of the Army Veterinary School, Aldershot, who have made an important series of observations on horses, using physostigmine freed from the convulsant calabarine. From the April number of the *Veterinary Journal*, 1888, the following observations are extracted:—

"The earliest indications we have of the action of the drug are loud intestinal murmurs, passage of flatus, with slight colicky pain; shortly this is followed by evacuation of the contents of the rectum, and the motions then pass at intervals of a few minutes, each becoming gradually softer, more watery, less formed in balls, until we reach the stage when the evacuations are moist and fluid, exactly representing cows' fæces. All

this time the abdominal disturbance has become greater, the animal lies down, but seldom rolls, the intestinal murmurs are louder, the passage of flatus almost continuous, straining marked, *fæces are voided with great rapidity*, often ejected with force, and several ounces of a brown coloured fluid will at this time accompany each motion. About two to two and a half hours from the time of injection the effects are commencing to pass off, and during this short time an almost incredible amount of fæces will have been excreted. Details on this point will be given below. Those who have had no previous experience of the drug and the results obtained will regard it as magical and marvellous. . . . .

"A horse received $1\frac{1}{2}$ grains of eserine (physostigmine) subcutaneously; it *acted in twenty-five minutes*, and produced in the first hour seven evacuations, in the second hour seven, the effect passing off in two hours and ten minutes.

"A horse received $1\frac{1}{2}$ grains of eserine hypodermically, which took twelve minutes to act, producing *seven evacuations in the first hour*, and then terminating.

"Another horse received $1\frac{1}{2}$ grains of salicylate of eserine hypodermically, producing a free action of the bowels in one hour. This case terminated fatally from ruptured stomach; and thus it was demonstrated that eserine could act upon the large intestines, in spite of the shock to the abdominal nervous system which a ruptured stomach causes.

"A pony received 1 grain of eserine hypodermically; three evacuations were produced in fifty minutes, and in eighty minutes from the time of injection eight evacuations had occurred. The case was a fatal one, the cause of obstruction being due to a small diaphragmatic hernia. Had the gut not been nipped so tightly, there is reason to believe the increased peristalsis might have withdrawn it.

"A horse received a few drops of a solution of eserine into the conjunctival sac; it shortly produced contraction of the pupil, which lasted fully two days.

"A horse received $1\frac{1}{2}$ grains of eserine by *injection into the trachea*; it took seventeen minutes to act, and produced in the first hour *twelve evacuations*, weighing 11 lbs. 13 oz., and a considerable quantity of flatus. The action then passed off.

"A horse received 1 grain of eserine hypodermically; it took forty-two minutes to act, and produced only one evacuation in one hour, accompanied by a considerable quantity of flatus.

"The same horse received 1 grain of eserine and 3 grains of pilocarpine by injection into the trachea; it took twenty-one minutes to act. In the first hour counting from time of injection, it produced fourteen evacuations, weighing 30 lbs. 6 oz.; in the second hour four evacuations, weighing 7 lbs. $6\frac{1}{2}$ oz.; and in the third hour two evacuations, weighing 2 lbs. $13\frac{1}{2}$ oz.; in *three hours a total of 40 lbs. 10 oz. of ingesta.*

"In comparing these two cases, the value of pilocarpine in addition to eserine is clearly demonstrated.

"A horse received $1\frac{1}{2}$ grains of eserine by the trachea; it acted in forty-one minutes, and produced in the hour five evacuations; during the second hour four evacuations. The weight was unfortunately not obtained, but the quantity of ingesta completely filled a stable bucket. The case was one of most obstinate constipation, and had received 6 drachms of aloes previously, which ultimately acted at the expiration of the usual time.

"Another horse received 1 grain of eserine with 3 grains of pilocarpine by the trachea, which acted in one and a half hours, producing in two and a half hours from time of injection eight evacuations, weighing 26 lbs.,

exclusive of loss. The pilocarpine produced its salivating effects in four minutes from the time of injection."

Mr R. Rutherford, Edinburgh, gave a horse, 15 hands, weighing about 950 lbs., 5 grains commercial eserine, which within half-an-hour caused profuse perspiration, convulsive breathing, with violent action of the diaphragm. About two hours later, when the symptoms were abating, he gave an additional 3 grains, which proved fatal in half-an-hour.

ANTIDOTES.—Neither the bean nor physostigmine are very soluble, and hence the stomach should be evacuated either by an emetic or the stomach pump. Physostigmine is antagonised by moderate doses of atropine. Professor Fraser found that rabbits receiving one and a half the lethal dose recovered if atropine was given simultaneously in doses of gr. i. to gr. $\frac{1}{20}$. While small doses act as antidotes, larger hasten fatal results. The atropine specially antagonises the cardiac paralysis. To a lesser extent physostigmine counteracts the effect of atropine. Chloral also somewhat antagonises physostigmine.

Locally applied the bean, its several preparations and alkaloids, **contract the pupil,** diminish intraocular tension, and cause spasm of accommodation. These effects are notable in ten to fifteen minutes, and reach their maximum in thirty to forty minutes. They depend either on stimulation of the fibres of the third nerve, or of the circular fibres of the iris (*Brunton*). Internal administration does not always contract the pupil, nor is it produced in birds even by local application.

MEDICINAL USES.—Professor Smith's and Rutherford's observations above detailed testify to the practical value of physostigmine in **combating intestinal spasm,** and hence gradually and safely **overcoming obstruction,** and affording fair prospect of rectifying some cases of volvulus and intususeption. These gentlemen administer the drug hypodermically and intratracheally, preferring the latter method on account of its acting more promptly, enabling more fluid to be introduced, occasioning less loss of the drug, and causing less inconvenience to the patient. They advantageously conjoin two or three grains of pilocarpine. Atropine, which also has marked effects in overcoming spasm of the intestines, might be alternated with physostigmine in these cases. Enemata will not be

neglected, and purgatives will be given where needful, but serious intestinal obstruction in all patients is most safely treated by intestinal paralysers and anodynes, enemata, and abstention from solid food.

The bean has been prescribed in **tetanus,** but the evidence in its favour is of a negative character. Professor Williams, using two to four ounces of the tincture, declares that any relief of the spasm is only temporary. More favourable effects might, however, be obtained by using the paralysing physostigmine without the convulsant calabarine. The bean has been prescribed in chorea and epilepsy, and as an antidote in poisoning by strychnine and atropine. It is applied in wounds and ulceration of the cornea, and alternated with atropine in breaking down adhesions caused by iritis.

Doses, Etc.—The bean is given to horses and cattle in doses of grs. xv. to grs. xxx.; to dogs, grs. $\frac{1}{4}$ to grs. $\frac{1}{2}$. As already indicated, the diverse character of the two alkaloids present in the extract and tincture, as well as in the bean, render it desirable to use as a paralyser and anodyne, the pure physostigmine which is conveniently employed in the form of salicylate, of which the dose for horses is grs. ii. to grs. iii., and for dogs, gr. $\frac{1}{20}$ to gr. $\frac{1}{10}$. Half these doses suffice when, as recommended by Professors Smith and Rutherford, the salicylate is dissolved, with careful stirring, in about an ounce of warm water, and administered by hypodermical or intratracheal injection. In intestinal obstruction more prompt and certain effects are obtained by addition of 2 to 3 grs. of pilocarpine.

CALCIUM AND ITS MEDICINAL SALTS.

Calcium belongs to the dyad class of metals, and to the group of alkaline earths. Its salts resemble chemically and physiologically those of magnesium and aluminium. Carbonate of lime is the great source of the calcium salts. They are **detectable** in solution by their yielding no precipitate with hydrochloric acid, hydrogen sulphide, or ammonium hydro-sulphide; a white precipitate with an alkaline carbonate; an immediate and abundant white precipitate with oxalic acid, insoluble in acetic, but soluble in

hydrochloric and nitric acids; but no precipitate with ammonia, which precipitates the compounds of aluminium and magnesium. Calcium salts give a reddish-yellow tinge to flame.

Calcium compounds have little affinity for animal textures, and are slowly absorbed and diffused. As with other metals, the oxide and carbonate nearly resemble each other, and are antacid and desiccant. The phosphate is a restorative. The chloride, persevered with for weeks or months, is said to reduce enlarged lymphatics, solidify tubercular deposits, and promote the healing of ulcers. Calx chlorata is stimulant, astringent, and antiseptic. Calx sulphurata, consisting of calcium sulphide and sulphate, is credited with the power of checking formation of pus and hastening its discharge.

Calcium Oxide. Lime. Quicklime. Calx. CaO.

When limestone, chalk, marble, or other form of calcium carbonate ($CaO\,CO_2$ or $Ca\,CO_3$), is mixed with coal and thoroughly burned, its carbonic acid (CO_2) is driven off, and the metallic oxide (CaO) or quicklime is left. It occurs in greyish-white irregular masses, has an alkaline, caustic taste, and a great affinity for water. It combines with about 24 per cent. of water, giving off much heat, and forming the **hydrate** or **slaked lime** $Ca\,(HO)_2$. A pint of water at 32° F. dissolves 13·25 grains of lime; a pint at 69° F., 11·6 grains; a pint at 212° F., 6·7 grains. The presence of sugar increases fully twelve times the solubility of lime in water. **Lime-water** is prepared by slaking a small quantity of freshly burned lime, agitating it briskly with a large quantity of water, allowing undissolved matters to subside, and after twelve hours syphoning off the clear solution. As it readily absorbs carbonic acid, it should be kept in closely stoppered bottles.

Actions and Uses.—Lime is irritant, mildly astringent, and antacid. It is a natural constituent of the animal textures, in which it occurs mainly in combination with phosphoric and carbonic acids. But, being present in most articles of food, extra supplies are seldom required. When swallowed, there is

probably deposited on the gastric mucous membrane a film of carbonate, which is dissolved by hydrochloric or lactic acid, slowly absorbed as chloride or lactate, reconverted in the blood into carbonate, held in solution by the free carbonic acid, and ultimately excreted by the kidneys, increasing the alkalinity of the urine, diminishing its irritant qualities, and perhaps exerting astringent effects on the urinary mucous membrane. Lime, especially when unslaked, and in contact with mucous and abraded skin surfaces, attracts water, forms a coating of carbonate, and possibly combines with albumin; but in larger amount, it irritates and superficially corrodes. Orfila mentions that $1\frac{1}{2}$ drachm administered to a small dog caused vomiting and considerable irritation, which lasted for about a day; and that three drachms caused vomiting, pain, languor, and death in five days.

MEDICINAL USES.—Limewater is used as **an antacid** in indigestion and diarrhœa in all classes of patients. Young animals, with which undiluted milk happens to disagree, are usually benefited by mixing the milk with one-fourth to one-half of lime-water, which prevents acidity and coagulation of the casein in large tough masses. Lime-water is appropriate for stomach derangement, while the less soluble chalk, retaining longer its antacid and desiccant properties, is better adapted for intestinal acidity. When acidity concurs with constipation, sodium bicarbonate is preferable in the proportion of a drachm to the pint of milk. Lime-water is occasionally given as **an antidote** in poisoning by the mineral acids and by oxalic acid. By itself, but better still when conjoined with turpentine, it **destroys bronchial filariæ,** often so troublesome in calves and lambs, and in the form of enema, brings away ascarides lodged in the lower bowels. Mixed with oil, glycerin, or vaselin, with a little boric or carbolic acid, it is applied in aphtha, and is occasionally substituted for zinc oxide in cases of eczema. Scalds and burns are often treated by **Carron oil,** which consists of lime-water mixed with an equal quantity of linseed oil. The more recent treatment consists in the immediate application of layers of cotton wadding, with gentle and equable pressure. Lime in solution is used for cleansing and deodorising stables, cow-houses, and piggeries.

Doses, etc.—Of quicklime, horses and cattle take ʒi. to ʒij; sheep, grs. xx. to grs. xxx.; dogs, grs. v. to grs. xx. Of lime-water the larger patients take f℥iv. to f℥v.; and the smaller, fʒij. to f℥i., given alone, or with glycerin, oil, or milk. Two ounces each of lime-water and gentian infusion, repeated twice or thrice daily, often check diarrhœa amongst feeble calves; half the dose answers for sheep. For calves and dogs, **saccharated lime** is used as an antacid and stomachic. It is made by rubbing an ounce of slaked lime with two ounces of sugar, transferring the mixture to a bottle containing a pint of water, shaking, and separating the clear solution with a syphon. It conveniently renders the milk alkaline, without diluting it as the lime-water does.

Calcium Carbonate. Calcis Carbonas. Carbonate of Lime. Chalk. $CaCO_3$.

Calcium carbonate occurs in the several forms of limestone, marble, calcareous spar, and chalk. When chalk is triturated with a little water, agitated with a larger quantity of water, and the mixture allowed to stand, the coarser fragments and foreign matters subside. The clear liquid is poured or syphoned off, and slowly deposits an impalpable powder, which, when dried in blocks, constitutes **whiting,** and when in smaller conical rolls is **creta præparata.** It is a dull white, amorphous powder, is tasteless, adheres to the tongue, owing to its porosity and its affinity for water, and effervesces with acids. It is a constituent of the bones of animals, of shells, and of corals. It is the common source of hardness in drinking waters, which, when pure, hold about two grains dissolved in the gallon; but carbonic acid increases the solvent power of the water. Sixteen grains are sometimes taken up, and in chalk districts much more, but when such hard waters are boiled, the carbonic anhydride is driven off, and calcium carbonate deposited in the kettles and boilers.

Actions and Uses.—Chalk is a cheap and convenient **antacid,** much used for the domesticated animals in the treatment of indigestion and chronic diarrhœa. It resembles lime, but is less irritant, and its effects extend beyond the stomach, through-

out the intestines, neutralising acidity, and leaving a protecting film of carbonate. It is an **antidote** for oxalic, carbolic, and the mineral acids. In a dry and finely divided state, it is used as a **desiccant** and **astringent** for abraded skin surfaces, burns, and ulcers.

DOSES, ETC.—For horses, ℥i. to ℥ij.; for cattle, ℥ij. to ℥iv.; for sheep, ʒij. to ʒiv.; for pigs, ʒi. to ʒij.; for dogs, grs. viij. to grs. xij. It is conveniently given in bolus, or suspended in milk, gruel, or mucilage. When administered in large or frequently repeated doses, the bowels should be kept open, in order to prevent its accumulation in the intestines. It is frequently conjoined with catechu and other vegetable astringents to arrest excessive discharges; with ginger and other carminatives, to control indigestion and diarrhœa; with opium or belladonna, to diminish irritability or pain. The following formulæ prove serviceable **as antacids, carminatives, and mild astringents**:—For **horses,** half an ounce each of chalk, gentian, and ginger is made up in the usual way with linseed meal and treacle or with glycerin; or chalk ℥i., opium ʒi., and creasote ♏ x., are made into bolus; or again, half an ounce each of chalk, catechu, and ginger are conjoined with one drachm of opium. For **cattle,** similar prescriptions are given, frequently in draught. For **sheep,** the like combinations are used in about one-fourth the dose. For **dogs,** a convenient pill is made with chalk and ginger, of each grs. x; with opium, grs. ij.; and aromatic confection, q.s. A draught of similar action is made with chalk, grs. x., laudanum and ether, of each ♏ xv., given in a little milk or soup. Any of these prescriptions may be repeated several times daily. Where it is sought to act chiefly upon the stomach, such medicines are fittingly given dissolved in starch solution as prepared by the laundress, or in spirit and water, administered according to circumstances, either hot or cold. Where the effects are to be extended throughout the intestines, the drugs are generally given in the **solid** form. For dyspeptic and diabetic horses suffering from acidity, a piece of chalk should be placed in the rack or manger or in the drinking water.

CALCIUM PHOSPHATE. Calcis Phosphas. Phosphate of Lime. $Ca_3 (PO_4)_2$.

Calcium phosphate is prepared by roasting bone earth until animal and carbonaceous matters are removed, dissolving the residue in diluted hydrochloric acid, precipitating the phosphates by ammonia solution, and washing. Thus purified, it is a light, tasteless, white, amorphous powder, insoluble in water, but soluble without effervescence in hydrochloric and nitric acids.

ACTIONS AND USES.—Calcium phosphate is present in bones and other animal textures; occurs abundantly in the intercellular fluid, and wherever cell growth is most active; and is hence **an essential constituent of food** and **a restorative.** Its absence in the dietary is shown by M. Chossat to induce softening of the bones and general wasting; it is deficient in the bones of pregnant animals. Milne-Edwards found that, when supplied to dogs whose bones had been intentionally fractured, more rapid union occurred. It is useful for rapidly-growing, rickety subjects; and conjoined with iron, for anæmic, badly-nourished, scouring young animals, beneficially restoring the phosphates, which in such cases are sometimes too freely removed. Bran and bruised oats owe in part their notable dietetic value for young stock to the large amount of calcium phosphate which they contain.

DOSES, ETC.—Horses and cattle take ʒi. to ʒij.; sheep and dogs grs. v. to grs. x. Small doses are preferable to large, which sometimes derange the bowels. They are conveniently given mixed with food, and in combination with an iron salt.

CALCIUM CHLORATA. Calx Chlorata. Chlorinated Lime. Bleaching Powder. A mixture chiefly of calcium hypochlorite, $Ca (Cl O)_2$ and calcium chloride ($Ca Cl_2$), with calcium hydrate $Ca (HO)_2$ and water.

Large quantities of this valuable bleaching agent are made in Glasgow, where it was first prepared by Messrs Tennant and Mackintosh in 1798. The process adopted is as follows:—

Chlorine gas, produced by the action of sulphuric acid on common salt and manganese black oxide, is transmitted into close chambers, where slaked lime, moistened with water, is spread on tiers of wooden trays. The lime, after being exposed to the chlorine gas for about four days, is found to have absorbed nearly half its weight of it; the precise changes occurring are not well understood, but the fresh bleaching powder consists of about 28 per cent. of calcium hypochlorite, 25·5 of chloride, 23 of calcium hydrate, and 24·5 of water (*Fresenius*).

Properties.—It it a soft, dull-white powder, with a feeble odour of chlorine, or rather of hypochlorous acid, and an acrid taste. When exposed to the air it deliquesces, absorbs oxygen, and evolves hypochlorous acid, which in its turn breaks up into the unstable chloric acid and chlorine gas. When heated or mixed with an acid, chlorine is rapidly given off. It evolves oxygen, and hence sometimes bursts closely stoppered bottles in which it is kept. It is not fully soluble in water, a portion of the lime remaining undissolved. The watery solution is colourless, or of a faint yellow tint, and has at first an alkaline, and subsequently a bleaching action on vegetable colouring matters. The intensity of its odour and the degree of its solubility are simple approximative tests of its strength and purity, and a good specimen yields at least 33 per cent. of chlorine.

Actions and Uses.—Bleaching powder is irritant, stimulant, astringent, antiseptic, and alterative; it is seldom given internally, but is used externally as a stimulant and antiseptic, as a deodoriser, and a disinfectant, and owes its several effects mainly to the hypochlorous acid and chlorine it so readily evolves.

Toxic Effects.—Hertwig gave horses and cattle one ounce to two pounds; sheep and goats one to eight drachms; and dogs half a drachm to four drachms. The smaller quantities produced scarcely any effect; the larger, besides local irritation, caused acceleration of the pulse, difficult breathing, increased warmth in the mouth, weeping eyes, abundant secretion of urine, having a curious odour of chlorine or prussic acid, and a white sediment, frequent copious alvine discharges, and in dogs,

vomiting. In horses the effects usually began in twenty or thirty minutes, and lasted from two to five hours. Considerable doses, when given repeatedly, did not impair appetite, but caused thirst and gradual emaciation.

Medicinal Uses.—Youatt recommended bleaching powder for hoven in cattle, and tympanitis in horses, in doses varying from two to four drachms, and ascribed its supposed good effects to its decomposing the gases evolved in the alimentary canal. But repeated careful trials made at the Edinburgh Veterinary College indicate that it is of little, if any, service in the majority of cases of hoven or tympanitis, whether in cattle or horses. It is an antidote in poisoning by hydrogen sulphide and ammonium hydrosulphide; and, with a respirator filled with bleaching powder, Mr Roberts explored in safety the sewers of the Bastile, which had not been opened for thirty-seven years, and were full of hydrogen sulphide and other noxious gases.

Externally it is used as a **stimulant** and **deodoriser** for unhealthy wounds, for removing the fœtor of foul discharges, and for destroying the micro-organism of ringworm and the parasite of mange and grease. Diluted solutions have been recommended for checking conjunctival ophthalmia, and other circumscribed and superficial inflammations, but are not so effectual as lead or zinc lotions. Although it does not arrest the action of enzymes, or prevent the reproduction of developed bacteria or their spores as promptly and effectually as corrosive sublimate or chlorine, it is superior as an antiseptic to sulphurous acid, bromine, iodine, salicylic and carbolic acids, and the permanganates (*Wernitz* and *Koch*). Its active gaseous products, moreover, readily attack and break up the products of putrefaction, and it hence proves an **effectual deodoriser.** Chlorinated lime, either in powder or solution, is spread about cow-houses and premises where contagious or epizootic diseases prevail. When free and rapid evolution of the hypochlorous and chlorine gases is desired, vessels containing the powder are set about, and sulphuric acid poured over them; a more gradual evolution is effected by the carbonic acid of the air when cloths saturated with a strong solution are suspended about the infected dwellings. Solutions varying from one to ten per cent. are employed for disinfecting hides, flesh, or excreta

of diseased animals. It has the disadvantage of a sickly smell, which is disliked both by horses and cattle; it is gradually converted into calcium chloride, which, having great affinity for water, leaves the floors, walls, and other objects to which the deodoriser has been applied, in an unsatisfactorily moist state; whilst its decomposing ammonia, urea, and such other unstable nitrogen compounds, greatly diminishes the agricultural value of any manure to which it is added. Scattered about stables or cow-houses, it keeps away flies; while neither rats nor mice frequent places where it is sprinkled, especially when mixed with sulphur.

Doses, etc.—Horses take ʒi. to ʒij.; cattle, ʒij. to ʒiv.; sheep, about ʒi.; dogs, grs. ii. to grs. v., given either in bolus, or with cold gruel, mucilage, or milk.

CAMPHOR.

Camphora. A stearoptine obtained from the wood of Cinnamomum Camphora. (Camphora officinarum). Imported in the crude state and purified by sublimation ($C_{10} H_{16} O$). (B. P.) *Nat. Ord.*—Lauraceæ.

The Camphor Laurel is a tall, handsome evergreen, cultivated in Japan and China, and in many European conservatories. Its wood and leaves evolve a camphoraceous odour when bruised, and yield about $\frac{1}{500}$ of their weight of camphor, which is sometimes extracted by dry distillation. In Formosa, whence comes most of the camphor imported to this country, the branches are cut into chips and boiled with water in wooden troughs; along with the steam the volatile camphor rises and condenses in earthen pots placed over the troughs; and on reaching this country is purified by mixing with a little charcoal, sand, lime, and iron filings, and re-subliming. Owing chiefly to increased demand, camphor has recently become scarce and dear.

Properties.—Camphor occurs in concavo-convex masses, about ten inches in diameter and three inches thick, which derive their form from the vessels into which they have been sublimed. It is white, translucent, crystalises in octahedra,

and has a bitter, pungent, cooling taste, and a strong, peculiar aromatic odour. It floats on water, its spec. grav., varying with the temperature, is about ·996. Exposed to the air, it slowly evaporates ; heated, it takes fire, and burns with a bright but sooty flame. It is tough and difficult to powder, unless with the addition of one-fonrth of its weight of spirit or a little volatile oil or sugar. It dissolves readily in ethers, acids, and oils, in about its own weight of rectified spirit, in eight times its weight of milk, and in 1000 times its weight of water. Camphor ($C_{10}H_{16}O$) is an oxide of terepene ($C_{10}H_{16}$)—the chief constituent of oils of turpentine, chamomile, cardamoms, cloves, hops, juniper, savin, and valerian. Associated with the terepene in these oils is an oxidised product or stearoptine corresponding with the colophony of turpentine. Continuously heated with nitric acid, camphor oxidises, and is converted into camphoric acid, $C_{10}H_{16}O_4$.

Sumatra or Borneo Camphor ($C_{10}H_{18}O$) is found in minute prisms in cavities in the wood of the Dryobalanops aromatica, and is distinguished from laurel camphor by its softness, friability, and opacity, its higher density, and its somewhat alliaceous odour. From Borneo, Formosa, and other parts of China, **fluid camphor oils** are obtained from several different trees. **Artificial camphor** ($C_{10}H_{16}HCl$) is got by the action of hydrochloric acid on oil of turpentine. **Camphora monobromata** ($C_{10}H_{15}BrO$) resembles bromine rather than camphor in its actions, and is sometimes used instead of the bromides, but is not so efficient.

Actions and Uses.—Large doses are irritant and narcotic; medicinal doses are stimulant, antispasmodic, anodyne, anaphrodisiac, and diaphoretic; externally it is antiseptic, and it relieves itching in various skin diseases.

Toxic Effects.—The several camphors closely resemble each other, and have many actions in common with the volatile oils. Full doses swallowed in coarse powder act as **topical irritants.** Given in fine powder or solution it is absorbed, in great part oxidised into camphoric acid, and **stimulates** the brain, spinal cord, heart, and respiratory functions, and this stimulation and control of higher centres developes its **antispasmodic** effects. As with other nerve

stimulants, **large doses,** however, **derange reflex functions,** inducing giddiness, delirium, convulsions, and stupor. It is excreted by the skin and bronchial membrane, and in less amount by the kidneys (*Bartholow*). Moiroud records that two ounces produced in horses convulsive movements and acceleration of the pulse, unaccompanied, however, by fatal results. Hertwig mentions that two to four ounces given to horses and cattle, two to four drachms to sheep, or one to three drachms to dogs, accelerate respiration and pulsation, communicate a camphoraceous odour to the breath, heighten sensibillty, and occasionally induce convulsions. Dogs besides exhibit imperfect power of controlling the movements of their limbs; and when the doses amount to three or four drachms, insensibility and death ensue. The vapour of camphor destroys fleas, bugs, moths, and spiders, exciting, enfeebling, and stupefying them. It has considerable **antiseptic** power. Koch found that one part to 2500 of water hindered development of anthrax bacilli.

MEDICINAL USES.—Camphor is a **nervine stimulant,** and hence usefully controls reflex excitability in gastro-intestinal, respiratory, urino-genital, and cutaneous irritability. It is occasionally used, especially in young animals, as a **gastric stimulant** and carminative In diarrhœa it is given with aromatics and a few drops of hydrochloric acid, or with ether and laudanum. Professor Robertson prescribed it with opium in enteritis in horses. Most veterinarians give it freely in catarrhal cases presenting dyspnœa, conjoining it with salines, ammonia salts, and belladonna. In chronic bronchitis in horses, Professor Robertson prescribed it with squills, and in convalescence from catarrhal complaints used a bolus consisting of a drachm each of camphor, gentian, ginger, and myrrh. For influenza and other exhausting diseases, whether in horses or cattle, **a stimulating draught** is often made with two drachms each of camphor and ammonium carbonate, and an ounce of ether, given in ale or cold gruel. **Sore throat** and irritable spasmodic cough are relieved by placing on the tongue, at intervals of two or three hours, an electuary made with equal parts of camphor, borax, and belladonna extract, reduced to a paste with ammonia acetate solution, and mixed

with eight or ten parts of honey or treacle. Small doses prescribed with belladonna **lessen urino-genital irritability,** resulting from cantharides or other causes. Its anaphrodisiac effects are not very notable in veterinary patients. It does not, as has been popularly believed, diminish the secretion of milk.

For dogs, grs. v. each of camphor and belladonna extract, with ʒj. of ammonia acetate solution, in a few ounces of water, is prescribed to **relieve cough** and **bronchial irritation.** Professor Williams recommends camphor and sweet spirit of nitre for allaying the restlessness and convulsions of **chorea.**

Externally it is applied either in oily or weak spirituous solution to **allay itching** in chronic eczema and urticaria. Dissolved in oil or other media, it is used to prevent attacks of flies. It is a constituent of soap, opium, belladonna, chloroform, turpentine, and other liniments.

Doses, etc.—For horses, ʒj. to ʒij.; for cattle, ʒij. to ʒiv.; for sheep and pigs, grs. xx. to grs. xl.; and for dogs, grs. v. to grs. x. When used for anodyne purposes, it is conveniently made into an emulsion with eggs or dissolved in milk or oil. For external use, it is dissolved in six or eight parts of proof spirit, in diluted acetic acid, linseed oil, or oil of turpentine.

CANNABIS INDICA.

Indian Hemp. The dried flowering or fruiting tops of the female plants of Cannabis sativa grown in India, and from which the resin has not been removed. It is known in India as gunjah or ganga. B. P. *Nat. Ord.*—Urticaceæ.

The cannabis sativa is grown in India, and also in various of the Southern States of America. Its properties depend upon an aromatic bitter resin—**Cannabin,** and the plant also yields a **volatile oil.** It is used in several different forms. Bhang consists of small bright green leaves, with a few flowering or fruiting tops and the adhering resin; and I am informed by Mr Richard Rutherford that it is the first season's growth. Gunjah consists of the leaf-stalks, with adhering brown leaves, dried flowering and fruiting tops, and resinous exudate, and is reported to be the growth of subsequent years. An Arabian preparation is known as haschish.

Actions and Uses.—Indian hemp is a **deliriant-narcotic anodyne** and **antispasmodic.** Bhang is widely used in India by all classes of people as a pick-me-up, and in larger amount to induce pleasing, dreammy narcosis. Similar effects are exerted on horses; the flagging appetite is improved, capacity for exertion increased, exhaustion and restlessness overcome. Gungah is more active, anodyne, and narcotic. It has long been used in India to dull sensibility during surgical operations both on man and animals. Sir Robert Christison stated that "for energy, certainty, and convenience, Indian hemp is the next anodyne to opium, and often equals it" (*Dispensatory*). Mr Richard Rutherford, Edinburgh, for several years used gunjah largely in India in the treatment of **colic in horses,** and informs me that it relieves spasm and pain as quickly as opium, but more permanently, and without arresting the action of the bowels, or leaving headache or delirium, as opium occasionally does. American practitioners sometimes prescribe it in diarrhœa, occasionally conjoining it with spirit of chloroform and aromatic spirit of ammonia. Mr Richard Rutherford recommends it in **tetanus,** remarking that it relieves irritability, spasm, and pain, without impairing the appetite, interfering with the action of the bowels, or producing delirium. More than half the cases he has treated with cannabis have recovered. It proves equally useful in tranquilising the involuntary spasms of **chorea in dogs.** In the form of injection or suppository it is sometimes substituted for opium in the treatment of irritable or painful conditions of the lower bowel or urino-genital organs.

Doses, etc.—The extract is the preparation generally used: horses and cattle take ʒ$\frac{1}{2}$ to ʒ1.; dogs, gr. $\frac{1}{4}$ to gr. 1. The tincture is given in about the same doses as that of opium.

CANTHARIDES.

Lytta Vesicatoria. Blistering or Spanish Fly. The dried beetle—Cantharis vesicatoria. *Class*—Insecta. *Order*—Coleoptera.

Cantharides flies are found in most parts of Southern Europe, Germany, and Russia, and occasionally along the south

coast of England. They settle on such trees and shrubs as the olive, lilac, privet, ash, elder, honeysuckle, and rose. During May and June, after night-fall or before dawn, the collectors, with their faces protected by masks and their hands by gloves, shake or beat the insects from the trees on which they feed, kill them by exposure to the fumes of oil of turpentine, or by immersion in boiling water or vinegar, and quickly dry them in the sun or by artificial heat. The flies used in this country were formerly brought from Spain (and hence their vernacular name of Spanish flies), but are now chiefly imported from Hungary, St Petersburg, and Messina, usually packed in barrels or cases containing from 100 to 200 lbs.

PROPERTIES.—The insect is of a copper-green colour, measures six to ten lines in length, and two to three lines in breadth, and weighs about a grain and a half. A little furrow, running along the head, neck, and body, divides it into two symmetrical halves; investing the fine gauze-like membranous wings is a pair of shining elytræ, or wing coverings, of a copper-green colour, and so indestructible that they have been recognised in the human stomach nine months after interment. The body, especially along its under surface, is covered with grey-white hairs; the head is large; the antennæ or horns are black and thread-like. The insect, which lives eight to ten days, deposits its larvæ in the earth, leaving them to be hatched by the heat of the sun. It has a resinous acrid taste, and a disagreeable penetrating fœtid odour. Powdered, cantharides is freely soluble in boiling water, alcohol, ether, acetic acid, and fixed and volatile oils. The active principle being volatile, no cantharidine preparation should be heated beyond 200° F. Its distinguishing **tests** are its vesicant action, and the brilliant green appearance of the wing-covers.

Cantharides, besides animal matters, acetic and uric acids, contains a bland oil, a fœtid acrid volatile oil, and **Cantharidin** ($C_{10}H_{12}O_4$), which is confined to the soft parts of the body, is present particularly in the female sexual organs, and constitutes about four or five parts to the thousand. It also occurs in the Mylabris Cichorii, common in India, and in most vesicant insects. It is slowly deposited, when an alcoholic solution of cantharides is concentrated; when pure, it crystallises in colour-

less scales or prisms, melts at 482° F., is insoluble in water, but soluble in alcohol, acetic acid, ether, chloroform, and oils; $\frac{1}{100}$ of a grain suffices to blister.

IMPURITIES.—As the powdered cantharides sold in the shops sometimes contains euphorbium and various cheap irritants, the flies should be purchased entire. Other insects are sometimes mixed with them. The species of Mylabris sold as Chinese blistering flies have two orange-coloured bands and spots on the wing covers. Activity of the flies is sometimes impaired by damp, long-keeping, and attacks of mites, moths, and beetles. Such parasitic attacks are prevented by keeping the fresh flies in closely-stoppered bottles with a few drops of acetic acid, or a few grains of camphor or ammonium carbonate.

ACTIONS AND USES.—Cantharides in large doses inflame the gastro-intestinal and urino-genital organs. Small doses are stimulant, aphrodisiac, and diuretic. Applied externally, cantharides stimulates and vesicates, and is used as a counter-irritant.

Cantharides **stimulates, irritates,** and, when applied in large amount, or repeatedly, it **inflames** and **vesicates** the skin or mucous surfaces. Blisters usually appear in three to twelve hours; and, after a variable but generally short time, they burst, and discharge a yellow, serous fluid, which dries into scrufy cicatrices. When freely or continuously used, the deeper-seated skin tissues are affected, and suppuration, ulceration, and sloughing ensue. When the true skin has thus been seriously inflamed, the hair bulbs are injured; the hair is removed, and permanent baldness and blemishing may result.

TOXIC EFFECTS.—Swallowed in considerable doses **gastro-enteritis** is produced; the cantharidin is absorbed, the mucous membranes generally are congested; the respiratory and urino-genital mucous surfaces are specially irritated; the kidneys are inflamed, the glomeruli and proximate tubules being first affected.

Orfila found that "three drachms of the tincture, with eight grains of powder suspended in it, caused the death of a dog in twenty-four hours, if retained in the stomach by a ligature on the gullet, insensibility being the chief symptom; and that

forty grains of the powder killed another dog in four hours and a half, although he was allowed to vomit. When administered by the stomach, that organ was found much inflamed after death; and if given in the form of powder, fragments of the poison were generally discernible. When applied to a wound, the powder excites surrounding inflammation; and a drachm will, in this way, prove fatal in thirty-two hours, without any constitutional symptom except languor" (*Christison on Poisons*). An ounce of powdered cantharides administered to a horse caused death in eighteen hours; and fatal effects are reported to have occurred where only one drachm was given (*Morton*).

The treatment of the gastro-intestinal or urinary irritation consists in the free use of mucilaginous drinks with opiates. Oils and fats are inadmissible on account of their favouring solution of any unabsorbed poison. When constitutional irritation has resulted from absorption of the cantharidin from a blistered surface, this should be dressed with soothing remedies.

MEDICINAL USES.—Small repeated doses are occasionally prescribed in **chronic catarrh.** In such cases Professor Robertson gave it with copiaba. It is sometimes serviceable in **chronic cystitis;** while strengthening the sphincter vesicæ, it prevents involuntary escape of urine. In some parts of Germany it is given to cows which are tardy in coming to service; but its aphrodisiac effects on either sex are uncertain, and seldom produced except by dangerously large doses. When administered for some time small vesicles usually appear on the skin, depending, it is believed, on the excretion of cantharidin.

EXTERNAL APPLICATIONS.—Cantharides, in properly regulated amount, stimulates, and hence **increases, the blood supply** of the part to which it is applied; it thus directly increases the **functional activity of the skin and hair bulbs,** and hence is used to induce a healthier condition of the dermis in some chronic scaly diseases, and to promote growth of hair. Ulcers and tardily healing wounds may thus also be stimulated, and their repair encouraged; while slowly developing abscesses, such as those of irregular strangles, are brought to a head. **Inflammatory products** are **liquefied and absorbed**—an effect familiarly illustrated by the action of a

blister on the swelling remaining around a kick or other bruise, or on the fulness and thickening resulting from a strain. The beneficial effects of a cantharides blister in **arresting inflammation** and **removing effusion** was often exhibited when blood-letting was more common than it now is, and phlebitis of the jugular vein of the horse was not infrequent. The blistering ointment well rubbed in along the course of the vessel seldom failed to remove the tense corded inflammatory swelling.

To produce inflammatory exudate, cantharides is usefully applied in open joints or bursæ, where the breach of continuity is small, as from perforation by a stable fork; exudate and swelling are thus produced sufficient to prevent escape of synovia. It is also applied in umbilical hernia in foals and calves; and while it mechanically prevents the descent of the intestine, it gradually obliterates the opening in the abdominal walls. Similar effects are sometimes obtained by moistening the adjacent skin with sulphuric acid.

Cantharides is much used as a **counter-irritant.** Like heat and moisture or cold, applied topically, the direct action on the external surface, through the nervous system, exerts reflex effects on adjacent, sometimes even on remote, parts. The vascular dilatation produced externally, frequently induces, as the application of cold notably does, vascular contraction of deeper-seated collateral areas. But whatever be the actual *modus operandi,* clinical experience testifies that **tension, inflammation, and pain are relieved.** Blisters applied experimentally to the chest or loins of dogs and rabbits, while producing external congestion, cause anæmia of the pleura and lungs, or of the deeper-seated muscles of the back. Professor Robertson has recorded that in pleuritic and other cases a blister so notably modifies morbid action, and relieves painful tension, that temperature is reduced 2° to 3°, and the pulse ten beats per minute. He preferred cantharides to mustard, believing it to cause less irritation and pain, and to produce more permanent curative effects. Professor Williams, however, maintains that cantharides and other blisters unnecessarily irritate most horses, and in acute diseases of the respiratory organs are neither so certain nor so satisfactory as hot fomentations.

In most cases of catarrh and sore throat the application of heat and moisture is certainly more effectual than blisters. Tedious, irritable conditions of the larynx, inducing coughing, are often, however, relieved by a good cantharides dressing. In the outset of **roaring** counter-irritation is often useful. In **acute attacks of bronchitis,** when mainly affecting the larger tubes, in conjunction with inhalation of steam, and after stuping the parts with hot water, it is serviceable. But Professor Robertson also speaks favourably of fly blisters in cases where considerable exudation blocks the smaller tubes. Their efficacy is seldom so obvious in pneumonia, especially when involving a considerable area. In **pleurodynia** and most stages of **pleurisy** cantharides is particularly serviceable; in the earlier stages it moderates acute inflammation, while later it checks and removes effusion. It is the counter-irritant usually applied in inflammation of the heart and pericardium. Although occasionally used, it is seldom of much value, either in colic or enteritis. In peritonitis it is seldom so effectual as in pleurisy, but was advised by Professor Robertson in chronic cases. Where acute inflammation extends over a considerable area of the peritoneum, it is desirable that the blister be applied some little distance to the side of, and not directly over, the closely underlying inflamed spot. Professor Williams and other good authorities recommend cantharides blisters in encephalitis and spinitis, as well as in chronic paralysis. Those cases of paralysis among cows depending upon **puerperal apoplexy** are usually benefited by moderate counter-irritation, maintained for a week or ten days. In **rheumatism** in all patients advantage frequently results from a good fly blister, the effects of which are kept up for several days.

Irritation and inflammation of joints, bursæ, ligaments, tendons, and bones are combated, and effused products removed, by blisters properly used. When an external surface or comparatively superficial textures are to be directly stimulated, the cantharides application must be mild, and not too long applied. When deeper-seated parts are to be acted on by counter-irritation, more active preparations are needful and their effects may be maintained by repetition. It is seldom admissible to apply cantharides directly to any part which is

hot, tender, or inflamed. In applying blisters to inflamed joints or bursæ, it is judicious to place them, not immediately upon, but somewhat above or below, the affected spot. Where continued effects are desired, mercury biniodide dressings are alternated with the cantharides, or substituted for it, or setons or the hot iron are used instead of blisters.

Owing to its liability to become absorbed and irritate the kidneys, it is an **unsuitable** counter-irritant in inflammation of the urinary organs. In common with all other causes of irritation, it must be avoided in tetanus. Unless on a very limited surface, aud in diluted form, cantharides must not be used in typhoid complaints or in weakly, exhausted subjects. It should not be applied to any portion of the skin in a highly vascular or sensitive condition, or where there is any tendency to erysipelas. In blistering dogs, special caution is required, as they are apt to rub the irritated parts, and cause sloughing. Cantharides sometimes acts with unexpected violence on the thin skins of well-bred horses, and for such subjects strong blisters are not advisable, and their application over considerable surfaces should be avoided. No horse should have all four legs blistered at once. Even a moderate blister in some excitable horses causes irritative fever, and has occasionally produced tetanus.

Doses, etc.—For horses, grs. iv. to grs. xx.; for cattle, grs. x to grs. xx.; for sheep and swine, grs. ij. to grs. viij.; for dogs, gr. ss. to gr. ij.; repeated once or twice a day; usually given with aromatics and bitters, in the form of bolus or tincture; administration suspended if strangury or any untoward effects occur.

Cantharides is **used externally** in the form of powder, tincture, vinegar, ointment, liniment and plaster.

Powdered Cantharides is principally used for keeping up discharges, and for scattering over mustard poultices and other stimulant applications to increase their activity.

Tinctures of Cantharides, vulgarly termed sweating blisters, are made of varying strength. Those used in human medicine are too weak for most veterinary purposes. One ounce of coarsely-powdered flies, macerated for seven days with fifteen or twenty ounces of proof spirit, forms a useful tincture of

medium strength. The activity is augmented by addition of liquor ammoniæ, or oil of turpentine. The tinctures in common use act speedily, but their effects are less powerful and permanent than those of the ointments. Though producing considerable irritation, they seldom cause blistering, unless applied repeatedly at short intervals. In using them, it is not essential that the hair be removed, nor even that the animal be kept idle. They may be applied repeatedly to the same spot without fear of blemishing.

Vinegar of Cantharides (Acetum Cantharidis)—a solution of one part of powdered flies in about ten of acetic acid—forms a prompt counter-irritant.

Ointments of Cantharides (Unguenta Cantharidis) are much used in veterinary practice. Their oleaginous constituents insure solution of the cantharidin, and render them easy of application. Many contain a number of ingredients, but the simplest are usually the best. A useful ointment of medium strength consists of one part of powdered cantharides to six of hog's lard, palm oil, resinous ointment, or vaselin. Such an ointment, when well made and applied with smart friction, acts effectually, and is little apt to blemish. Another excellent ointment is made with one part each of powdered cantharides, Venice turpentine, and resin, with four parts of vaselin, palm oil, or lard. The powdered flies are digested with the oily matters in a covered vessel, over a slow fire or in a water-bath, for twelve hours, and the vessel placed in boiling water for fifteen minutes; any wax or resinous matters used to give consistence are then melted and stirred in, any volatile flavouring oil added, and the mixture, if required, strained through muslin. Euphorbium, sulphuric acid, and occasionally corrosive sublimate and arsenic, are sometimes needlessly added; but unless in small amounts, such irritants are apt to cause unnecessary pain, sloughing, and blemishing.

In **cattle practice,** counter-irritation is generally produced with mustard and hot water, but some powder or strong ointment of cantharides, mixed with the mustard, greatly increases its effects. **For dogs,** a convenient ointment is made with an ounce each of powdered cantharides and oil of turpentine, and twelve ounces of lard.

To insure full vesicant effects, the hair, where rough or long, should be clipped or shaved off; the skin, especially if dirty, washed with soap and water; and the ointment then spread over the part, and well rubbed in. The extent of surface to be covered must obviously depend upon the nature, seat, and extent of the malady. To prevent the ointment, when liberally applied, from spreading beyond the desired limits, the blistered spot may be surrounded with an edging of resinous ointment. The blister, while rising, often causes considerable irritation, and the animal, if permitted, will rub or bite the blistered part. In the horse, this should be prevented by securing the head to the rack, putting on a cradle, or, when required, tying up the tail; in the dog, by the use of the muzzle. On the next second or third day, the blistered part should be fomented with warm water, and dressed with oil, lard, vaselin, or carron oil. If sufficient effect has not been produced, a little more of the blister may then be applied.

Liniments of Cantharides are merely liquefied ointments, and, in respect of activity, usually occupy a mediate place between ointments and tinctures. They generally consist of one part of cantharides, and six to ten parts of rape or linseed oil. Oil of turpentine is sometimes added. Some practitioners use a liniment of one part of cantharides and four or five of tar—a combination not very commendable, and not easily rubbed in.

Plasters of Cantharides are made in the same manner as ointments, but rendered more strongly adhesive by the addition of resin or pitch. To prevent their being displaced by the powerfully corrugating action of the panniculus carnosus, they are usually applied in the melted state, immediately covered by a little tow or teased lint, and enveloped in a suitable bandage.

CARBOLIC ACID.

ACIDUM CARBOLICUM. Phenic Alcohol. Phenol. Phenic Acid. Phenol Hydrate. $C_6 H_5. HO$.

Carbolic acid is an occasional constituent of the urine of most animals, is present in benzoin and some plants, and is

one of the many products of coal tar. Cannel coal is its most prolific source; but it also occurs in other coals as well as in bitumen and petroleum. It is **extracted from the heavier coal tar oils,** which distil at from 300° to 400° F. They are treated with caustic soda; on standing, two layers separate; the upper, consisting of the higher homologues of benzene (p. 270); the lower, of sodium phenylate. This is diluted with water, neutralised with sulphuric acid, and purified by fractional distillation. Thus purified, it occurs in pulverulent crystals, and in acicular crystalline masses. It is colourless, or faintly red or brown, absorbs moisture, melts at 91·5° F., boils at 371, has a specific gravity of 1060 to 1066, and a peculiar pungent taste and odour. It is devoid of acid reaction, is liquefied at 60° F. by five to ten parts of water, and dissolved by fifteen parts of cold water. It is freely soluble in glycerin, oils, alcohol, ether, alkaline solutions, and acetic acid. It coagulates albumin. It destroys the particulate cells which produce the several fermentations. With an equivalent of sulphuric acid, it forms sulpho-carbolic acid, which produces a series of definite stable, soluble, crystallisable salts — the sulpho-carbolates (p. 315), which exhibit in mild degree the actions of carbolic acid. With nitric acid, it forms explosive compounds and picric acid ($C_6 H_2 (NO_2)_3 OH$) an antiseptic, and much used as a yellow dye. When carbonic anhydride is passed through dry powdered phenol-sodium, salicylic acid is produced.

Carbolic acid is **distinguished** by its odour. Bromine water forms, even in very dilute aqueous solutions, a pale yellow precipitate of tribromo-phenol. Concentrated sulphuric acid, containing a little potassium nitrite, gives a brown colour, changing to green when gently heated with phenol. An aqueous solution, even if containing $\frac{1}{1000}$ part, when treated with a drop or two of iron perchloride solution, produces a mauve colour. Wood tar oils and crude creasote, apt to be mistaken for impure carbolic acid, are distinguished by their being less soluble in water, by boiling and drying up about 212° F. instead of at 370°, and by not solidifying about 40° F.

The strongly empyreumatic red brown liquid carbolic acid contains the uncrystallisable, acrid methyl-phenol or cresol ($C_6 H_4 . (OH). CH_3$). **Calvert's Carbolic powders** consist

of 20 to 30 per cent. of carbolic acid, incorporated with refuse from the alum works. **M'Dougall's disinfecting powders** contain about 33 per cent. of calcium carbolate and 59 per cent. of magnesium sulphite. A mixture of carbolic acid and bleaching powder has been patented. **Blast furnace** residual **oils,** now produced largely in Scotland, consist of 20 to 35 per cent. of phenoloids, soluble in caustic soda, resemble wood-tar products, and are used for preserving timber.

ACTIONS AND USES.—Carbolic acid is an antiseptic and disinfectant. Large doses, like the mono-basic alcohols, are irritant and narcotic poisons. It is administered in various contagious and zymotic diseases, with a view of preventing or arresting the development of particulate micro-organisms. It is extensively used in surgery as an antiseptic, antiparasitic, and occasionally as a local anæsthetic, stimulant, rubefacient, and caustic. It is employed for most of the purposes of a general disinfectant.

GENERAL ACTIONS.—**It precipitates albumin** and **destroys micro-organisms.** It is not nearly so active as corrosive sublimate, chlorine, iodine, sulphurous acid, and some other antiseptics, in arresting the action of ptyalin, pepsin, diastase, and other organic ferments, or in killing or preventing the development of bacteria; but Koch's experiments show that about one part to 500 prevents the growth of anthrax and other bacilli. Oats, barley, beans, and lentils, soaked in a one per cent. solution, do not germinate. Milk is maintained unchanged by $\frac{1}{54}$th part of acid. Healthy pus is kept aseptic by $\frac{1}{100}$th part. Two per cent. is, however, needful effectually to secure the antiseptic state of vaccine lymph, glanderous pus, and other virulent fluids. As the carbolic gradually volatilises, not only may fresh infection occur, but spores and organisms, the development of which has been arrested, may regain activity.

A strong solution applied to the skin, or to a mucous surface, coagulates albumin, acts as a topical **irritant** and **caustic;** **anæsthises** not only the skin, but the underlying structures; causes a stain at first white, but shortly becoming brown; and leaves a dry, roughened surface, from which the shrivelled epidermal scales subsequently peel off. "It is a powerful

poison to all tissues, paralysing both muscle and nerve when applied directly to them, and without previously stimulating them."—(*Brunton*).

Full doses when swallowed, besides producing these local effects, cause **increased salivation,** and in carnivora usually **vomiting,** with **gastro-enteritis** and **collapse,** which may end fatally. It is absorbed. Like other members of the alcohol series, it first **stimulates and subsequently paralyses the medulla and spinal cord,** and involves also the cerebral centres. The respiratory and vaso-motor centres are first stimulated with the effect of quickening respiration, raising blood-pressure, and accelerating the pulse; but as the paralysing effects of the poison are developed, respiration is slowed, and the blood-pressure falls. Stimulation of the sweat centre increases perspiration. Implication of the cerebral centres gives rise to the restlessness, irregular movements, convulsions, and anæsthesia which different doses and stages of poisoning present. Moderate doses **kill by paralysis of respiration,** but larger doses, besides, cause **cardiac paralysis.** It is **excreted** in part by the lungs and skin, mainly **by the kidneys,** and chiefly in the form of sulpho-carbolates, detectable two or three hours after administration by bromine water or iron perchloride. The urine thus containing it is preserved for a considerable time from putrefaction; but if it stands long, becomes brown, depending upon hydro-quinoine and other phenol products undergoing further oxidation. Excretion is tolerably rapid; carbolic acid can seldom be found in any notable amount in the urine either of men or animals twenty-four hours after the exhibition of the last dose.

Toxic Effects.—Two drachms prove immediately fatal to **dogs**; two drachms killed a full-grown cat in two minutes (*Dr Sansom*). Dr Cullen, of Calcutta, found that one drachm given to small dogs caused excitement, dilated pupils, shallow stertorous breathing, convulsions, and death in ten minutes (*Veterinarian* for September and November 1872). Half-drachm doses given to small dogs caused immediate trembling, agitation, frothing at mouth, sometimes vomiting, staggering, occasionally convulsions, and recovery in about an hour. Three or four drops placed under the wings of sparrows caused ex-

citement, restlessness, and death in half an hour; toads, earthworms, beetles, ants, and fleas were promptly poisoned (*Lamaire*). Two drachms repeatedly given by the late Mr Romanes of Leith to a **donkey** had no very notable effect. Ounce doses have only slight and transient effects on **horses.** Poisonous doses immediately cause dogs, rabbits, and other animals to reel, move in jumps, and fall as when intoxicated by alcohol; they tremble and show muscular weakness, cough, froth at mouth; the pulse is small, quick, irregular, and intermittent; albuminuria and hæmaturia are occasionally present; shallow gasping difficult breathing, collapse, paralysis, more or less anæsthesia, and occasionally convulsions, precede death.

By whatever channel it is introduced into the body, its characteristic effects are produced. Dressings used in human surgery sometimes cause nausea, vomiting, giddiness, high-coloured urine, and occasionally collapse, and even death. **Scabby sheep too freely dressed** occasionally suffer from congested and inflamed lungs, linger for weeks, and even then die. **Dogs are particularly susceptible,** even a single dressing incautiously applied over a large surface produces dulness, trembling, and disinclination for food, continuing for several days. Stronger dressings, within a few minutes cause excitement, blowing, unsteady gait, and occasionally fatal collapse. A considerable skin surface, freely wetted, is recorded by Professor Williams to have produced "gradual failure of the heart's action;" whilst in other cases the dog has fallen into a state of marasmus, with sunken eyes, fœtor of the breath, formation of sordes on the teeth, "tarry" fæces, total loss of appetite, and death in six to twelve days (*The Principles and Practice of Veterinary Surgery*).

THE POST-MORTEM APPEARANCES are, brown discolouration and corrugation of the membrane of the mouth and fauces, and sometimes of the stomach; strong solutions leave patches of redness and inflammation in the stomach and small intestines. The blood is dark-coloured and feebly coagulated, but the corpuscles are unchanged (*The Antiseptic System*, by Dr A. E. Sansom, 1871). Where death has occurred within a day after the poison has been taken, a smoky phenol odour pervades the body, and the poison has been discovered in most of the internal organs; but

where life has been prolonged beyond twenty-four hours, the volatile drug may not be discoverable. Dr Cullen records that the vessels of the brain are full of fluid blood; while serous effusion is generally observable on the surface of the brain and within the ventricles. The lungs, in cases that have survived several days, are frequently ecchymosed.

ANTIDOTES.—Where the poison has been swallowed, any unabsorbed portion should be removed by the stomach pump. Pharyngeal and gastric irritation are allayed by inhalation of steam, medicated by a little laudanum, and by demulcent drinks and saccharated lime. Neutralisation of the poison, by conversion into phenol-sulphuric acid, and excretion by the kidney, are hastened by administration of sulphates, conveniently given in the form of sodium sulphates.

Carbolic acid is a representative member of the benzol or aromatic series of carbon compounds, notable for their antiseptic and febrifuge properties (p. 269), and most closely resembles creosote. It has many properties in common with the volatile oils and camphors, and is allied to the mono-basic alcohols.

MEDICINAL USES.—It is prescribed in **diseases produced and propagated by micro-organisms.** In **cattle plague** it appears to lower advancing temperature, and prolong even where it does not save life. Mr William Crookes injected 105 grains in six ounces of water into the circulation of a cow suffering from cattle plague, with little apparent injury beyond what might have been expected from the injection of any simple fluid, and the patient gradually recovered. M. Bouley, President of the Commission appointed by the French Academy of Sciences to investigate **malignant pustule,** reports that in attacks experimentally produced by inoculation, every patient died; but when cattle thus inoculated were dosed with two or three drachms daily of carbolic acid, four out of five animals recovered. A like favourable result followed the use of the acid in horses and sheep inoculated with pustule. In **Texas cattle fever** an approved remedy has been twelve ounces each of carbolic acid and sodium bicarbonate, mixed with four fluid ounces of glycerin; two tablespoonfuls of the mixture being given thrice daily in a quart of water. In black quarter and other **anthrax** cases, Professor Robertson advised half a drachm

in a pint of water three or four times daily, conjoined with morphine, when there was abdominal pain. He also used subcutaneously carbolic acid ♏ ij., morphine hydrochloras solution ♏ xxx., and water ♏ xxx. Mr Priestman and other practitioners have used carbolic acid with some benefit in the treatment of contagious pleuro-pneumonia in cattle. It has been administered in **foot-and-mouth** complaint, in which glycerol and other solutions are also applied locally with zinc and lead lotions. Most **catarrhal influenza** cases amongst horses are notoriously contagious, and the severity of the attack is materially abated, while the spread of the disease is checked by administration of antiseptics and by spraying the nostrils and throat with one per cent. carbolic solution. In such cases, and also in chronic bronchitis and pharyngitis, such solutions are mixed with air or steam, and used as inhalations. In tedious malignant cases of strangles and in purpura, it is prescribed with iodine or iron, or both ; and is also applied externally.

Stomatitis and **ulcerations** about the mouth and throat are treated with the acid conjoined, sometimes with iodine, or with tannin and glycerin. **Actinomycosis,** after the diseased surface has been scraped, is directed by Professor Walley to be dressed with four parts of carbolic acid and one of iodine, dissolved in six or eight parts of glycerin. Added to the ordinary prescriptions used in dyspepsia, diarrhœa and dysentery, it **checks fermentative changes** and lessens acridity and fœtor of the excreta. With oil of turpentine and opium tincture, it is used for **intra-tracheal injections** in calves suffering from stronguli. Carbolic solutions relieve the itching and swelling occasioned by stings of bees, wasps, mosquitoes, and ants, and, promptly used, prevents mischief from dissection wounds.

They **check** the **parasitic growth** of the tinea form of ringworm, although in such cases they are not generally so effectual as iodine or iron chloride dressings. Alternated with other remedies, a few applications are often serviceable in that form of eczema popularly known as **grease.** In these and other cases, where there are foul discharges, it proves a useful addition to lead, zinc, or other appropriate dressings. In **eczema in dogs,** attended with profuse discharge, the acid is sometimes of benefit applied mixed with starch powder.

For most cases of eczema the wood-tar oils are, however, more suitable than those derived from coal-tar. Diluted solutions are used for **destroying ticks, keds,** and the **acari** of scab and mange. The preparation known as M'Dougall's Sheep-dipping Composition has been favourably reported on by the Australian Government Commissioner appointed to inquire into the spread and cure of scab in that colony. After thorough scrubbing with soap and water, preceded by shaving when the hair is thick or matted, one part of acid to twenty of oil is used for **mange in dogs**; but to avoid dangerous absorption, too large a surface must not be dressed at a time.

Surgical Uses.—Sir Joseph Lister has taught the rational use of antiseptics in surgery. He has demonstrated the necessity of protecting wounds, whether made by accident or by the surgeon's knife, from the attacks of those widely-distributed micro-organisms, which on abraded surfaces set up irritation and suppuration, and, moreover, lead to septicæmia. In preparation for any considerable operation, the parts are washed with an antiseptic solution, and kept moistened with it throughout. A steam-spray producer is, besides, constantly used by many surgeons for distributing the spray over the wound and dressings. Lest micro-organisms be inadvertently introduced, the hands of the operator and his assistants are washed with a one to forty carbolic solution; while instruments—the silk horse-hair catgut or wire for sutures, the tow sponges, etc.—are kept in a vessel containing a one to twenty carbolic solution.

In extensive wounds, likely to be irritated by continuous contact of considerable amounts of carbolic acid, there is first applied a protective of oiled silk varnished with copal and coated with dextrin, which allows the silk to be uniformly wetted with the antiseptic solution. Over this protective—or, in ordinary cases, directly upon the wound—is laid six or eight folds of freshly-prepared carbolic lint, made of coarse unbleached gauze or muslin, which has been impregnated by prolonged soaking with a mixture of one part of crystallised carbolic acid, four of resin, and four of paraffin. Through these dressings, the air, before reaching the raw surface, is

filtered and deprived of micro-organisms. To retard undue evaporation of the volatile antiseptic, and prevent discharges soaking through the dressing, a piece of Mackintosh cloth, wetted with the carbolic solution, is applied with the india-rubber coating next the wound. Over this, and underneath the appropriate strappings, are placed, as required, folds of carbolised lint tow or oakum.

With such antiseptic precautions, human surgeons have reduced the mortality of capital operations by more than one half; and equally favourable results are attained by veterinarians. Indeed, with the aid of anæsthetics and antiseptics, operations which hitherto could scarcely be attempted may now be undertaken with fair prospect of success. Such are the opening of the horse's abdominal parietes for the reduction of strangulation or intussusception of the bowels; for the removal of concretions or of impacted masses of ingesta; and for excision of tumours from the liver and other internal organs.

Carbolic acid is applied, in all classes of patients, to most descriptions of **wounds,** in order **to prevent and arrest attacks of micro-organisms.** Incised or lacerated wounds should be washed according to their condition, with a one to forty or one to twenty solution before and after being secured with stitches or sutures. Broken knees and open joints are cleansed, and at intervals irrigated with carbolic lotions. When wounds for several days have been treated with strong carbolic solutions, an aseptic condition may be maintained, and healing usually hastened by milder dressings of boric, salicylic, or sulphurous acids. Added to Carron oil, it allays pain, and prevents or limits suppuration of **burns and scalds.** Over-reaches and other serious bruises, after being drenched with a watery solution, are covered with a few folds of carbolised lint or oakum, and when painful, enveloped in a large bran poultice. Similar treatment is serviceable in carbuncle of the coronary band, occurring in hard-worked horses in wet, cold weather. A saturated watery solution is used in **foot-rot among sheep;** but in chronic cases, and where reparative power is deficient, it is usefully alternated with turpentine and oil, and where granulations are superabundant, with copper sulphate. **Farcy**

buds and **ulcers** are stimulated, and their healing promoted, by thorough soaking with strong carbolic. **Fistulæ** of the poll, withers, or lateral cartilages cleansed of micro-organisms by strong acid, and provided with a dependent opening, frequently heal if protected by carbolic gauze from fresh incursions of organisms.

Injuries of the uterus or vagina, resulting from parturition, leucorrheal, and other discharges, and metritis in all animals, are treated with glycerol and other carbolic solutions, with the effect of abating irritation, noisome discharge, and straining. No treatment is so effectual in **metritis in ewes,** the prevalence of which might be materially abated if shepherds would observe greater cleanliness, and wash their hands with an antiseptic fluid before rendering assistance to ewes lambing. Such precautions are specially needful where *post-mortem* examinations have been engaged in, where dead lambs which have lain about for some days have been skinned, or where cases of metritis have been handled. No one who has been in contact with such a contagious complaint can enter the lambing pens without much risk of distributing the specific bacteria.

Carbolic acid is seldom used as a caustic. Concentrated solutions applied to **boils** frequently cause their abortion, and prevent their spreading; are sometimes injected into lymphatic glands swollen from pyæmia, and into tuberculous, cancerous, and melanotic tumours. Injected into the swellings on cattle or horses, caused by the œstrus bovis, it kills the larvæ. Painted over the skin, strong carbolic solutions cause superficial **local anæsthesia,** sufficient for the opening of abscesses, but insufficient for the painless insertion of setons, or for moderately deep firing. Eight or ten per cent. solutions are occasionally applied as **topical stimulants,** and rubefacients for sore throat and rheumatic joints.

Carbolic acid is used for the **disinfection** of stables, kennels, cow-houses, piggeries, and poultry pens; of railway horse-boxes, cattle trucks, and loading places, and of cattle vessels and landing stages. M'Dougall's or Calvert's disinfecting powders are conveniently sprinkled daily throughout the stables of many omnibus, cab, and carrying establishments of London, Liverpool, and other large towns, at an annual

cost of about 5s. for each horse. Thus employed, carbolic acid is not injurious or distasteful either to the animals or their attendants: it drives away flies and fleas; arresting decomposition, it prevents unpleasant smells; fixing ammonia, it increases the value of manure with which it has been mixed. To insure purification of infected premises, the antiseptic must be freely and frequently used in the condition of powder, fluid, spray, or vapour, or in several of these forms. Solutions of less than one per cent. are not to be relied on. The vapour is readily evolved by sprinkling the acid on live coals or on a hot metal ptate. Besides smearing the walls and woodwork with the crude brown acid, during the prevalence of infectious and zymotic diseases, sheets wetted with it should be suspended here and there to catch floating germs. Along with carbolic acid, sulphurous acid or sulphites may be fittingly used. To destroy these germs or limit their formation, animals infected with contagious disorders should have antiseptics given internally, and should be lightly sponged daily with a one per cent. solution. Contagious germs may thus be prevented spreading to healthy subjects, which by daily administration of antiseptics may moreover be rendered less liable to suffer from toxic micro-organisms which may reach them.

DOSES, ETC.—Horses and cattle take ♏xv. to ♏xl.; sheep and pigs, ♏v. to ♏viii.; dogs, ♏i. to ♏ii. The crystallised acid is best for internal use. It is made into bolus with meal; but is more readily absorbed, more regular in its effects, and less likely to develop local irritation, when given either in water or in glycerin and water. One part by weight of acid rubbed in a mortar with four of glycerin forms a convenient compound readily miscible with water or other solvents. An **ointment** is made by rubbing in a mortar fifteen to twenty grains of acid with an ounce of benzoated lard. The **liniment** usually contains one part of acid shaken up with twenty of rapeseed oil, which is preferable to the drying linseed oil. For external purposes it is often usefully mixed with soap. Watery solutions are most penetrating and best fitted for cleansing wounds or skin surfaces. For dusting irritable surfaces it is mixed with starch, lycopodium, and occasionally with charcoal and plaster of Paris.

Sulpho-Carbolic or **Sulpho-phenic Acid** ($H. C_6 H_4 O. HSO_3$) is prepared by mixing, with the aid of heat, equivalent proportions of carbolic and sulphuric acids. When slowly crystallised, it forms thin, colourless, deliquescent needles; it has less odour than carbolic acid; at 400° F. it becomes red; at 540° F. it boils. It is soluble in water, alcohol, and ether. When the acid in solution is saturated with the oxides or carbonates of the alkalies, earths, or metals, there are obtained crystalline, soluble, almost odourless, usually colourless, stable sulpho-carbolates, which possess in mild degree the actions of carbolic acid, and were carefully examined by Dr A. E. Sansom (*Antiseptic System*, 1871). The sodium salt ($(Na C_6 H_5 SO_4)_2 H_2 O$) is a tasteless antiseptic and mild astringent, given to horses and cattle several times daily, in doses of grs. xx. to grs. lx., and to dogs in grs. v. to grs. xv. The calcium salt has been used in human practice in indigestion, diarrhœa, and dysentery. The iron salt is tonic and antiseptic. The zinc and copper salts conjoin the antiseptic and astringent properties of their components. These sulpho-carbolates are excreted by the kidneys in great part unaltered, and Dr Sansom records that so effectual are their antiseptic properties that the urine of animals receiving medicinal doses has been kept for six months without undergoing putrefaction. But although useful for topical purposes, they probably do not readily give up their carbolic acid in the body, and have not fulfilled the expectations formed of them as internal antiseptics.

CASCARILLA BARK.

CASCARILLÆ CORTEX. The dried bark of Croton Eleuteria. B.P.
Nat. Ord.—Euphorbiaceæ.

Cascarilla Bark is principally imported from the Bahama Islands in quills about the size of a drawing pencil, and varying from two to four inches in length. Its outer surface is fissured, and usually covered with a light-coloured lichen; its inner surface is smooth and light brown. It has a strong, pungent, rather nauseous taste; its aromatic odour is increased by heat, and recommends it as a constituent of fumigatory

pastilles. It contains the neutral crystalline bitter cascarillin ($C_{12}H_{18}O_4$), 15 per cent. of two resins, and 1·5 of a pungent volatile oil, one portion of which is isomeric with oil of turpentine.

Actions and Uses.—Cascarilla is an aromatic and bitter **tonic** and **stimulant,** allied to chiretta and resembling cinchona, but less active, and occasionally used in indigestion, diarrhœa, and convalescence from exhausting diseases.

Doses, etc.—For horses, ʒij. to ʒiv.; for cattle, ℥i.; for sheep and swine, ʒi. to ʒij.; and for dogs, grs. x. to grs. xl., given in bolus, infusion, or tincture.

CASTOR OIL.

Oleum Ricini The oil expressed from the seeds of Ricinus communis. (B. P.) *Nat. Ord.*—Euphorbiaceæ.

The Castor Oil plant, or Palma Christi, is generally considered to be Jonah's gourd. When cultivated in the colder parts of Europe, is an annual shrub four or five feet high; in Spain and Sicily it reaches a height of twenty feet; in the southern latitudes of India, in Central Africa, and various parts of North and South America, it becomes a large tree. The *nat. ord.* Euphorbiaceæ, besides the castor oil and croton plants, includes a tall Brazilian tree, the coco-purgatif, which yields the oil of Danda or assu juice, resembling castor oil, but greatly more active.

The officinal part of the castor oil plant are **the seeds,** three of which are contained in each capsule. Two varieties are met with, the one the size of beans; the other and commoner, somewhat smaller. Both have the shining yellow-white epidermis, mottled with red-brown streaks and spots. The seeds comprise about 25 per cent. of ligneous husk, 8 per cent. of moisture, and nearly 70 per cent. of kernel, which contains about 50 per cent. of **the castor oil** associated with 20 of albumin, 18 of cellulin, 2·4 of sugar and mucilage, traces of œnanthic aldehyde, and a small quantity of **an active purgative principle,** which has not been isolated, and mostly remains

after expression of the oil. Professor Tuson, of the Royal Veterinary College, London, exhausting the seeds with boiling water, extracted a crystalline alkaloid, allied to emulsin, devoid of active purgative property, which he named **ricinine.**

Castor oil is manufactured in London, largely imported from the East Indies and America, and in smaller quantities from Italy, the West Indies, and Australia. Various modes of **extraction and purification** are adopted. In London the carefully shelled seeds are crushed in a screw or hydraulic press, the oil purified by rest, filtration, and bleaching. In the East Indies mucilage and albumin are got rid of by heating the expressed oil with boiling water, and straining it through flannel. In America, the seeds, deprived of husk, are exposed to gentle heat, in order that the oil may be more readily expressed; the crude oil is freed from mucilage and albumin by boiling with water until perfectly transparent when cool; 25 per cent. of best oil is thus got. In Jamaica the bruised seeds are boiled with water, and the oil skimmed off as it rises to the surface,—a process which yields, however, an inferior and dark-coloured specimen. The Continental plan of extracting the oil by alcohol or carbon bisulphide is expensive and inconvenient.

Properties.—Oil obtained by these various methods differs slightly in activity, but considerably in colour, flavour, solubility, and keeping properties. The English castor oil, prepared by expression alone, is usually rather dark; the East Indian, principally imported from Calcutta, is of superior quality and moderate price; the American or United States oil is very free of taste, but at low temperatures deposits margarin; the Italian, imported since the Exhibition of 1862, commands the highest price (Pereira, 1872). Cold drawn castor oils, prepared by expression alone, or with only a very slight degree of heat, are generally preferred; for when a high temperature is employed, either in roasting the seeds or boiling the oil, the purgative principle is volatilised or acrid matters are developed.

Castor oil, when fresh and well prepared, is viscid, almost colourless, and of a faint oily odour and taste. Although lighter than water, it is one of the heaviest of the fixed oils, its

specific gravity at 60° F. being ·969. Exposed in a thin layer it thickens, gets rancid, and after a time entirely dries into a varnish-like film. Castor oil and alcohol are mutual solvents; the oil is soluble in one volume of absolute alcohol and four of rectified spirit and in ether; is easily miscible with other oils; saponifies with alkalies, yielding glycerin, palmitic, and other fatty acids, and the special ricinoleic acid ($H.C_{18} H_{33} O_3$). Such saponification caused by the alkaline secretions of bowels is believed to develop, as in the case of croton oil, the active principle.

IMPURITIES.—Castor oil is adulterated with croton oil to increase its activity, with lard and bland oils to reduce its cost. Pure oil is distinguished by entirely dissolving in its own weight of absolute alcohol, and in four of rectified spirit. (B.P.) Inferior sorts are dark coloured, but become translucent by exposure to sunlight, and filtration through animal charcoal; while disagreeable acrid taste and odour may in great part be removed by repeated agitation with water containing calcined magnesia and coarse animal charcoal.

ACTIONS AND USES.—Castor oil **seeds** are irritant and purgative, have caused fatal gastro-enteritis in human patients, and appear to be more powerfully irritant than the oil extracted from them. When crushed, they form an Indian cure for mange. A decoction of **the leaves** is applied by the women of South Africa to their breasts to increase the secretion of milk. **The oil** is a mild purgative, closely resembling linseed and the other fixed oils.

MEDICINAL USES.—The oil emulsionised mainly by the alkaline bile in part is absorbed, but the greater amount, little changed, passes through the bowels, increases both peristalsis and secretion, rarely causing griping, and imparting to the dejections a glazed appearance. For **horses,** castor oil, like other bland oils, is a mild cathartic, useful for young and weakly subjects, and where the bowels or urino-genital organs are in an irritable state. For **cattle and sheep** it is more frequently prescribed or replaced by the less expensive rape or linseed oils. In the **dog** it is more active than in man, and, for delicate subjects, a mixture of equal quantities of castor and olive oils is often used. Its causing occasionally

emesis in dogs does not result from any specific emetic action, but from its nauseous oleaginous taste, and is obviated by giving the oil free of rancidity and beat up with an egg, with mucilage, a little spirit, or ether.

Acting with little irritation or griping, it is prescribed in **irritable conditions** of the digestive organs of horses, as in diarrhœa, dysentery, enteritis, and peritonitis; in hernia; advanced pregnancy; affections of the kidneys and bladder; in purpura and bilious influenza, when more drastic purgatives might unduly irritate, or where reiterated doses require to be given. The anthelmintic effects sometimes ascribed to it are slight, and dependent upon its purgative action. Foals and calves, for several days after birth, sometimes have no movement of the bowels, and the removal of obstructive masses of mecomium, and the natural actions of the intestine, are best secured by administration of castor oil and enemata. In cattle practice, it is useful in diarrhœa and inflammation of the digestive organs, and, united with Epsom salt in doses of half or three quarters of a pound of each, produces prompt and certain effects. For young calves it is the best of purgatives. It proves a safe and easy purge for pigs. The bruised seeds are much used by native Indian farriers for the **cure of mange**; and the late Thomas Pritchard, of Madras, informed me that two or three dressings usually suffice to remove the disease. For enemata, it is generally superseded by rape or linseed oil. As an external demulcent, it is unsuitable on account of its tendency to become rancid. A drop placed in the conjunctival sac lessens irritation after removal of a chaff or other foreign body from the eye.

Doses, etc.—Castor oil seeds are conveniently given to the dog or pig to the number of six or eight, triturated with linseed meal, made into bolus, or rolled in a piece of meat. The dose of oil for the larger quadrupeds is about a pint; for sheep and pigs, f℥ij. to f℥iv.; for dogs, f℥i. or f℥ij., for cats, about f℥i. It may be given alone or mixed with linseed oil, with gruel, milk, or aromatics; to increase its activity, it is combined with small quantities of oil of turpentine or of croton; to control undue irritation, as in diarrhœa and dysentery, it is prescribed with laudanum, spirit of chloroform, or warm starch gruel.

For delicate or pampered dogs, a palatable laxative emulsion is made by shaking together an ounce each of castor oil and syrup of buckthorn, with twenty minims of spirit of nitrous ether.

CATECHU.

GREY CATECHU; Catechu Palidum; Gambier; an extract of the leaves and young shoots of Uncaria Gambier. B.P.—*Nat. Ord.*—Cinchonaceæ.

BLACK OR BROWN CATECHU. Catechu Nigrum. Cutch or Terra-Japonica; the aqueous extract of the wood of Acacia Catechu, of Acacia Suma, of other Leguminosæ. and of plants of other natural orders.

The Uncaria Gambier, producing the **pale catechus** (*cate*, a tree, *chu*, juice), is a stout climbing shrub, inhabiting the islands of the Indian Archipelago, and cultivated for its astringent juice. A decoction made of the leaves and young roots is evaporated, worked into red-brown earthy-looking masses or cubes, with surfaces about an inch square.

The **black or brown Catechus,** chiefly brought from Bengal and Burmah, are derived from several trees, largely from the Acacia Catechu, a native of India and Africa. The Acacia Suma, a large tree growing in Bengal, Burmah, and Southern India, has a white bark used for tanning, and red heart wood from which catechu is also made. The wood of these and of other trees is cut into chips and boiled with water; the decoction concentrated either by fire or the heat of the sun; and the extract cut or moulded into square cakes or masses.

The pale and brown catechus are very similar in **properties** and **composition;** are porous and opaque; brittle, breaking with a granular fracture; under the microscope, exhibit minute, needle-like crystals; are without odour, but have a sweet astringent taste. They are soluble in alcohol and ether, partially soluble in cold water, almost entirely dissolved by boiling water, with which they form red-brown solutions. They consist of about 40 per cent. of **catechu-tannic acid,** which is soluble in cold water; and of **catechin or catechuic acid** (C_{13} H_{12} O_5),

which is also a modification of tannic acid, deposits in acicular crystals, from boiling watery solutions of catechu, and is soluble in alcohol and ether. They also contain the yellow colouring matter quercitin.

Actions and Uses.—Catechu is **astringent.** It forms insoluble compounds with albumin and gelatin, and like other tannin-containing substances, is used in making leather. It is not so powerfully astringent as oak bark or galls, but is more astringent than kino, the inspissated juice obtained from incisions made in the trunk of Pterocarpus Marsupium; than rhatany, the dried root of Krameria Triandria; than logwood, the sliced heart-wood of Hæmatoxylon Campechianum; or than bearberry or uva-ursi leaves (p. 277).

Catechu is administered to the several domestic animals for the arrest of chronic mucous discharges and hæmorrhage, especially from the throat and alimentary canal. In persistent diarrhœa, it is conjoined with aromatics to allay flatulence; with opium to relieve irritability and spasm; with alkalies, magnesia, or chalk, to counteract acidity. A convenient prescription for many cases of diarrhœa, consists of three ounces each of catechu, prepared chalk, and ginger, and six drachms of opium, made, as is most suitable, either into mass or draught. This will make eight doses for a horse, six for a cow, and eight or ten for a calf or sheep. For these ruminants the dose is conveniently given suspended in starch gruel. Catechu is occasionally applied to sluggish wounds and ulcers, to excoriations on the udder of cattle, and for the ordinary purposes of a vegetable astringent.

Doses, etc.—For horses, ℨi. to ℨiij.; for cattle, ℨij. to ℨvi.; for sheep and swine, ℨi. to ℨij; and for dogs, grs. iv. to grs. xx. These doses are administered three or four times a day, with sufficiency of mucilage or gruel to cover their astringent taste. An **infusion** is readily prepared for veterinary purposes, by pouring boiling water over coarsely powdered catechu, digesting by the fire for an hour, and straining. Flavouring ingredients may be added as required. The B. P. orders the **tincture** to be made with catechu, in coarse powder, two ounces and a half; cinnamon bark bruised, one ounce; proof spirit, one pint; macerate for seven days in a closed vessel, with occasional

agitation; strain, press, filter, and add proof spirit to make one pint. For external purposes, the powder infusion and an ointment are used.

CHAMOMILE FLOWERS.

ANTHEMIDIS FLORES. The dried single and double flower-heads or capitula of the Anthemis nobilis. From cultivated plants (B. P). *Nat. Ord.*—Compositæ.

Chamomile flowers are extensively cultivated in the warmer parts of England; are gathered during dry weather; exposed for a short time on trays in the shade; and carefully stored and kept very dry. Both varieties, but especially the single, have a hot, bitter taste, and a strong aromatic odour. They contain bitter extractive matter, soluble both in water and alcohol; a small quantity of tannin; traces of the bitter anthemic acid; and 0·60 to 0·80 per cent. of **volatile oil,** usually got by distillation of the whole plant, of a pale blue or green colour, gradually becoming yellow-brown, and consisting of a mixture of ethers, chiefly of the angelates and valerianates of butyl.

ACTIONS AND USES.—Chamomile flowers are mildly stimulant, aromatic, stomachic, and tonic; full doses produce emesis in dogs. The infusion is sometimes given in atonic dyspepsia and diarrhœa. Horses and cattle take one to two ounces; calves, sheep, and swine, a drachm. They are occasionally used for fomentations and poultices. Like many other **volatile oils,** that of chamomile **lowers reflex irritability,** and hence is useful in dyspepsia, diarrhœa, and spasmodic cough.

CHARCOAL.

Two varieties of charcoal, or carbon (C), are used in medicine and pharmacy—**wood charcoal**, or carbo ligni, and **animal charcoal**, or carbo animalis. The former is prepared by piling billets of hard wood into heaps, covering them with turf and sand, and leaving a few apertures for admission of air. The pile is ignited; after the flame has risen through the

whole mass, the openings are closed, and combustion proceeds slowly without access of air. The high temperature dissipates moisture, breaks up the complex vegetable matters into simpler forms, producing empyreumatic gases and tarry fluids (pp. 172 and 186), and leaving a charred residue of about one-fifth the weight of the original wood, and consisting of chemically-pure carbon and ash, with oxygen, hydrogen, and traces of nitrogen retained in the porous mass. Oils or resins, when burned in a deficiency of air, produce **lamp-black**—a finely divided amorphous carbon.

Animal charcoal, also known as bone or ivory black, is chiefly prepared from bones, which are boiled to separate fatty matters, and heated in close vessels until the ammoniacal gases cease to be disengaged. The fixed residue contains about 10 per cent. of carbon, 88 per cent. of calcium phosphate and carbonate, and 2 per cent. of iron carbide and silicide—mineral matters, which separate the carbon particles, and greatly enhance its value for the removal either of colours or odours.

Both vegetable and animal charcoal are remarkable for their porosity; are of a brown-black colour, are insoluble and inodorous, readily absorb moisture, gases, and most vegetable colouring matters. Animal charcoal is distinguished by its greater density, its incombustibility, its bitter taste, its large proportion of phosphates; and also by its greater power of absorbing both colouring and odorous particles.

ACTIONS AND USES.—Charcoal is a desiccant, antiseptic, and deodorant, and is used as a decoloriser in pharmacy, sugar-refining, and other arts. One volume of good boxwood charcoal absorbs into its pores 100 volumes of ammonia gas, 50 of hydrogen sulphide, and 10 of oxygen. The oxygen thus retained decomposes and deodorises noxious gases which come into contact with the charcoal. Air laden with sewer gases or contagious micro-organisms is purified by passing it over charcoal. Brown sugar in solution passed through animal charcoal is deprived of colouring matter; crude spirit is robbed of its fousel oil; foul water is cleansed of organic impurities. Urine, heated with it, parts with colouring matters, urea, and uric acid, but not with any sugar it may contain. Vegetable acids, alkaloids, and their salts, are sometimes purified by charcoal;

but for these pharmaceutic purposes it has the disadvantage of retaining, not only colouring particles, but portions of the drugs—a property, however, which renders it serviceable as an antidote in poisoning with arsenic, aconite, strychnine, and even prussic acid. The charcoal mechanically envelops and holds the poisonous particles; half an ounce, swallowed immediately after a grain of morphine or strychnine, is stated to prevent absorption.

Sprinkled over meat or game, or placed in barrels of water intended for long keeping, it attracts and retains septic matters, and hence **retards putrefaction.** Unlike chlorides of mercury or zinc, or other powerful antiseptics, it does not, however, attack or destroy organised germs. Whilst passing through the alimentary canal, it checks fermentative changes, lessens acrimony and fœtor of the fæces; probably also removes mucus, and exerts some amount of healthy stimulation. As an **absorbent** and **deodoriser,** it is occasionally sprinkled over suppurating or foul wounds, or scattered on the poultices applied to them. Equal parts of charcoal, gum-arabic, and colophony constitute a useful **hæmostatic.**.

DOSES, ETC.—For the horse, ʒiv. to ℥i.; for cattle, ℥i.; for sheep and pigs, ʒi. to ʒiij.; and for dogs, grs. x. to grs. lx. It is usually given suspended in gruel or other mucilaginous fluid. **Raised to a low red heat** shortly before it is used, its absorbing power is much increased, for gases and organic matters are thus burned out of its pores. The charcoal fouled in sugar refining and other processes is thus cleansed for repeated use.

CHLORAL—CHLORAL HYDRATE.

Chloral is **prepared** by passing dried chlorine gas into absolute alcohol for twelve or fourteen days, or so long as the spirit will absorb it. The oily-looking pungent liquid chloral or tri-chloraldehyd (CH_3 COH) is **purified** by distillation with sulphuric acid, subsequently with a small quantity of lime, and when mixed with water, evolves much heat, and becomes the solid hydrate ($C\,Cl_3.\ COH.\ H_2O$).

Chloral hydrate occurs in colourless crystals, is neutral,

aromatic, bitter, pungent, and permanent in air. It melts at about 133° F. and boils at 205° F. It is soluble in less than its own weight of water, alcohol and ether, and in four parts of chloroform. The caustic alkalies, and in less degree the alkaline carbonates, decompose it into chloroform and an alkaline formiate. A hundred grains dissolved in an ounce of distilled water, and mixed with 30 grs. of slaked lime submitted to careful distillation should yield not less than 70 grs. of chloroform. Inferior specimens, besides being of imperfect strength, are apt to contain chlorinated organic impurities which render them yellow and cloudy, acrid and irritating, imperfectly soluble in water, on which they float as oily drops, while instead of hypnosis, they produce nervous excitement.

ACTIONS AND USES.—Chloral hydrate slightly and temporarily stimulates, and notably depresses and paralyses the cerebro-spinal centres. Medicinal doses are anodyne, hypnotic, and anæsthetic. It is used locally as a stimulant, anodyne, and antiseptic.

GENERAL ACTIONS.—**It destroys micro-organisms**; one part in 1000 hinders development of anthrax bacilli; it has about the same antiseptic strength as carbolic acid. Personne exhibited at the Academy of Sciences, Paris, the body of a dog perfectly preserved in chloral hydrate for fifty-five days. In concentrated form it is a **topical irritant**, and hence when swallowed, causes a burning sensation in the throat, and sometimes vomiting and purging. Diluted solutions are **readily absorbed.** The drug acts apparently without undergoing decomposition into chloroform, which is not discovered in the blood tissues or expired air of animals receiving chloral, and only appears in the urine when it contains sufficient amount of free alkali to decompose the chloral. After slight and temporary stimulation it **depresses and paralyses the cerebro-spinal centres.** Respiration is slowed; the pupil in most animals contracts; sleep is produced; the action of the heart after slight and brief stimulation is slowed, and blood-pressure reduced. Larger doses impair reflex irritability and sensibility, and lower temperature sometimes to the extent of 6° or 8° F. Death results from **cardiac and respiratory paralysis.** The heart is arrested in diastole, with the right cavities distended.

There is no paralysis of muscles or motor nerves. The drug is **eliminated** by the lungs, skin, and kidneys.

TOXIC EFFECTS.—Dr B. W. Richardson, in an extended series of experiments on the lower animals, found that fishes and pigeons were narcotised by $1\frac{1}{2}$ to 2 grains; mice by one-third of a grain; rabbits, weighing 85 ounces, by 30 grains (*Medical Times and Gazette*, vol. xi., 1869). 180 grains produce fatal effects in man, but dangerous symptoms have occasionally been developed by one-fourth of that amount. Mr T. A. Dollar, of New Bond Street, gave a horse suffering from spasmodic colic two ounces in water; the spasms were speedily removed, but for twelve hours the patient remained very dull and sleepy. Mr F. J. Mavor, of Mayfair, gave a horse four ounces of chloral hydrate in water; in five minutes he fell down insensible, perspired freely, his muscles relaxed, his pupils dilated (?); his pulse, at first accelerated, gradually became normal, respirations were quickened, until in an hour they numbered 36. The temperature from 100° F., fell in two hours to $95\frac{2}{5}$, but two hours later rose to $97\frac{1}{5}$. In half an hour he was in a quiet sleep, lasting one and a half hours, when he attempted but failed to rise, and shortly again slept, the breathing being slow and heavy, the skin cold, the sphincters relaxed. Four hours after receiving the draught he was restless, shivering, but disposed to feed, continued in this state for several hours, and suffered next day from bronchitis, from which he gradually recovered. Mr Mavor gave a healthy horse four ounces in ten ounces of water; in half an hour he was restless, but drowsy, passing fæces frequently; his pupils dilated (?). He continued in this state for fully three hours, when he was slightly delirious, but gradually became more quiet. Eight hours later the effects had passed away (*Mavor and Burness, "Actions of Medicines"*).

The treatment of poisoning consists in maintaining the temperature by warm clothing, hot applications, stimulants, and hot coffee. Dr Lauder Brunton and Professor Stricker found that animals which received lethal doses recovered, if wrapped in cotton wool and kept in a warm atmosphere. Although chloral is an antidote to strychnine, the antagonism of strychnine to chloral is not so marked.

Medicinal Actions.—Chloral hydrate **quiets irritability** and **causes sleep.** Conjoined with morphine, and either swallowed or used hypodermically, it relieves gastro-intestinal irritation and some of those cases of muco-enteritis so deadly in heavy draught horses. Small doses are serviceable in some attacks of **canine asthma,** and in violent **paroxysmal coughing** both in dogs and horses. It quiets the excitability and spasms of **chorea, epilepsy,** and **hysteria,** and temporarily relieves those of tetanus and hydrophobia, especially when it is used hypodermically. Professor Robertson used it successfully in **tetanus** in horses. It **antagonises** the tetanic convulsions of **strychnine.** Administered to rabbits along with lethal doses of strychnine, sleep is produced, and the creature recovers. Chloral is also antagonistic to physostigmine and picrotoxine, but to act as an effectual antidote the slower acting chloral must be given before, at the same time, or within two minutes after, these quickly acting convulsants (*Report of the Edinburgh Commission of the British Association on the Antagonism of Medicines*). Mr Robert Littler, of Long Clawson, gives it with benefit in the outset of those cases of **parturient apoplexy** in cows in which there is intense nervous excitement and violent cramp of the muscles of the hind extremities. Conjoined with bromides, it is indicated in cases of **phrenitis.** A like combination abates the irritable cough and sleeplessness frequently occurring in **canine distemper.** Injections and suppositories, in which opium is frequently also used, allay irritability and straining of the lower intestines and urino-genital organs. French veterinarians frequently use chloral-hydrate as an anæsthetic, dissolving it in three parts of water, and injecting it into the veins (p. 48). With an equal quantity of camphor, and mixed with 6 or 8 parts of vaselin or simple ointment, a soothing mixture is obtained which allays the itching of various skin complaints. A diluted solution is sometimes applied as a stimulant antiseptic to foul wounds.

It should not be prescribed where there is weak irregular action of the heart or congested lungs.

Chloral hydrate **resembles** chloroform and ether as well as amyl-nitrite, opium, and bromides, and is allied to butyl-chloral hydrate, bromal hydrate, paraldehyd, and hypone (p. 329).

Unlike chloroform and ether, it cannot, however, be inhaled, and anæsthesia is produced only when full doses are swallowed or injected into the veins; nor is it so effective as a local anæsthetic. In its power of relieving spasm and lowering arterial pressure, it bears some resemblance to amyl-nitrite. It is allied to bromides and cannabis indica in its quieting irritability of cerebral centres. As an anodyne, its effects are limited as compared with those of opium, but for the relief of pain it is usefully conjoined both with morphine and atropine.

Doses, etc.—For horses, ʒij. to ʒiv,; for cattle, ʒiv. to ℥i.; for sheep and pigs, ʒss. to ʒij.; for dogs, grs. v. to grs. xv.; repeated every two or three hours, and conveniently administered in syrup. For enemata and hypodermic injection about half the dose given by the mouth usually suffices, and should first be tried. Continued use of the drug does not establish tolerance as in the case of alcohol or opium. For relief of general irritability it is prescribed with bromides, opium, or belladonna; for relief of pain, with opium, belladonna, or camphor.

Butyl-Chloral Hydrate, formerly called croton-chloral-hydrate, is prepared by passing a stream of dry chlorine for 24 hours through acetic-aldehyd, separating the butyl-chloral by fractional distillation, and by addition of water, converting it into the hydrate ($C_4 H_5 Cl_3 O. H_2 O$). It forms pearly crystalline scales, which are pungent, acid, and disagreeable to the taste. It resembles chloral, but is less powerful, has less depressant cardiac action, paralyses specially the fifth nerve, and parts supplied by it, and has been prescribed in human medicine in facial neuralgia, migraine, and as a hypnotic instead of chloral in weak heart (*Brunton*).

Bromal Hydrate ($C_2 Br_3 O H.$), partaking of the character of its bromine constituent, is more irritant than chloral-hydrate. It increases the salivary, nasal, and bronchial secretions, and induces more preliminary excitement and more marked cardiac paralysis. It poisons in smaller doses; 4 grs. suffice to kill a four lbs. rabbit with symptoms of cyanosis, dyspnœa, and convulsions.

Paraldehyd is believed to be a polymeric of aldehyd ($C_6 H_{12} O_3$), is a colourless fluid and a pure narcotic of about half the strength of chloral.

Hypone chemically is phenyl-methyl-acetone ($C_6H_5.CO.CH_3$). Below 60° F. it is in white acicular crystals; above this temperature it is a liquid, with a strong smell of bitter almond and orange. It is sometimes used as a substitute for chloral.

CHLORINE.

Chlorine is **prepared** by heating common salt and manganese black oxide with sulphuric acid. It is a chemical element (Cl), a yellow-green gas, with a peculiar suffocating odour, an astringent taste, two and a half times as heavy as air, soluble in less than half its volume of water at 60° F. Under a pressure of four atmospheres it forms a bright yellow liquid. For nearly a century moist chlorine has been used for bleaching. Water charged with two volumes of chlorine gas constitutes the **liquor chlori**—a yellow-green, chlorine-smelling liquid, readily decomposed by air and sunshine; the B. P. solution containing at least 0·6 per cent., the U. S. P. 0·4 per cent. of chlorine.

Actions and Uses.—Chlorine, whether as gas or in solution, is irritant, stimulant, antiseptic, deodorant, and disinfectant.

One part in 8540 of a watery solution arrests the action of ptyalin on starch paste; one 7411 part arrests the action of diastase; one 27·167 part arrests the action of pepsin. Although not so active as corrosive sublimate, one 22·768 part kills developed bacteria; but one 1431 part is required to prevent their reproduction, and 1008 to prevent reproduction of spores. One part to 1500 prevents development of anthrax bacilli. The **bleaching** and **antiseptic** actions of chlorine are believed to result from the breaking up of complex bodies by the **chlorine seizing** their **hydrogen,** while the **nascent oxygen** thus liberated exerts active oxidation.

Applied to the skin or mucous surfaces, it causes irritation, relieved by lime-water, white of egg, soap, or diluents. Irritation of the air-passages, induced by the insufficiently-diluted gas, is counteracted by inhalation of ether, weak ammonia, or the vapour of warm water or of alcohol.

Medicinal Uses.—Diluted chlorine gas is inhaled, or the fresh solution applied in spray, to relieve ulcerated or diph-

theritic **sore throat** in horses, and to **abate** the **discharge** and **fœtor** from diseases of the facial and frontal sinuses. Both gas and solution are used for the **destruction of stronguli** infesting the air-passages of calves and lambs, and the liquor chlori is now frequently introduced into the trachea. For destruction of these bronchial stronguli, many practitioners now employ, intratracheally, the equally effectual but less irritant sulphurous acid solutions, while stock-owners also continue to use turpentine drenches. The liquor chlori is used as a **stimulant antiseptic and deodorant** for the same purposes as chlorinated lime and soda. It relieves the itching of various skin diseases.

For **disinfecting** or **deodorising** purposes, the materials for evolving chlorine should be placed in earthenware vessels in the upper parts of the boxes or sheds, in order to facilitate diffusion of the heavy vapour. One part each of common salt and manganese black oxide, intimately mixed, are treated with two measures of oil of vitriol, diluted with two measures of water. For more gradual production of the gas, bleaching powder is mixed with potash alum. Where chlorine is used for thorough disinfection, the buildings must be cleared of animals; large volumes of gas liberated; sunlight admitted to intensify the action; the walls and woodwork washed with a strong watery solution. It may be fittingly used in conjunction with the tar acids, but is incompatible with sulphurous acid.

CHLOROFORM.

CHLOROFORMUM. Trichloromethane. $C\,H\,Cl_3$.

Chloroform was discovered in 1832, about the same time, by Soubeiran and Liebig; its effects on the lower animals were described by Dr Glover in 1842; while its valuable anæsthetic properties were first discovered and applied by the late Sir James Y. Simpson in November 1847. Since then it has been largely and successfully used for the alleviation of human suffering during surgical operations, parturition, and various diseases, and has also been applied to similar purposes in veterinary practice.

Chloroform, by direction of the B. P., is **prepared** by distilling together ethyl-alcohol, chlorinated lime, slaked lime, and water. The reactions which occur are not thoroughly understood, but the final result is probably as follows:—

$$3\,C_2H_6O + 8\,Ca(OCl)_2 = 2\,CHCl_3 + 8\,H_2O + CO_2 + 5\,CaCl_2 + 3\,CaCO_3.$$

It may be readily prepared by decomposing chloral hydrate by an alkali. Chemically, it is a substitution derivative from marsh gas, CH_4, three of the H atoms being replaced by three of Cl.

Purification is effected by (1) repeated agitation with water, which washes away saline acid and some organic impurities; (2) shaking with sulphuric acid (scrupulously free from nitric acid), which chars and removes the last traces of organic oils; (3) admixture with slaked lime and calcium chloride, which gets rid of acid and water; and (4) careful distillation; while better keeping is secured by addition of one per cent. by weight of ethyl-alcohol.

PROPERTIES.—Chloroform is a limpid, colourless, neutral fluid, with a density of 1·49, a sweet taste, and a fragrant, ethereal, and apple-like odour. At ordinary temperatures it volatilises entirely. **Its vapour is four times heavier than air.** It boils at 140° F. Though not spontaneously inflammable, it can be burned around a wick saturated with alcohol, forms a green, sooty flame, and evolves hydrochloric acid. Alcohol, ethers, oil of turpentine, and carbon bisulphide dissolve it readily, but water takes up only about $\frac{1}{200}$ part. It readily dissolves volatile oils, wax, resin, and alkaloids. Freshly-drawn blood, treated with five per cent. of chloroform, is rendered liquid, and of a bright arterial hue; hæmatin crystals form after a time; the amount of oxygen is augmented, that of carbonic acid diminished; the red blood corpuscles are shrunk, their power of absorbing oxygen is impaired, they deliquesce and disintegrate; but no such changes occur in the blood of patients receiving ordinary doses of the drug.

IMPURITIES.—Chloroform carelessly prepared or imperfectly purified contains **volatile organic oils,** which, if inhaled, induce nausea and headache. Such specimens have an unpleasant pungent odour when evaporated from the back of the hand

and are blackened by agitation with sulphuric acid. Samples containing more than the authorised one per cent. of alcohol have their specific gravity, proportionally lowered, lose bulk, notably when shaken with water, and moreover become cloudy at temperatures approaching 32° F. Traces of sulphuric acid are discovered by the usual barium test; chlorine and hydrochloric acid by silver nitrate. **The purity** of chloroform is also judged by its odour when evaporated, its behaviour when agitated with sulphuric acid, its reaction on litmus, and its specific gravity, which is lowered by the ordinary adulterations.

Actions and Uses.—Chloroform, by whatever channel it is introduced into the body, temporarily and slightly stimulates, and more permanently and powerfully paralyses the cerebrospinal nervous system. The vapour is inhaled to produce anæsthesia. Medicinal doses swallowed are stimulant, antispasmodic, and anodyne. Applied topically, it is rubefacient, refrigerant, anodyne, and a local anæsthetic.

General Actions.—It **precipitates albumin, dissolves protagon,** the essential constituent of nerve-centres, nerves, and red blood corpuscles, and retards oxidation of blood (*Brunton*). Applied to the skin, it **evaporates,** causing a sensation of cold; but if evaporation be prevented, it **irritates.** Hence, when swallowed, it stimulates the flow of saliva, excites gastric secretion and movements, in men and dogs occasionally causing emesis, and develops **carminative** and **antispasmodic** actions. By whatever channel it is absorbed, it **acts on the nerve centres** much in the same manner as alcohol, but, compared with alcohol, its stimulant action is slight and brief. Full **anæsthesia is quickly produced** by inhalation of chloroform vapour. The effects are divisible into four stages—1. Imperfect consciousness; 2. Excitement; 3. Anæsthesia; 4. Paralysis (p. 46).

The vapour inhaled **first stimulates** and **subsequently paralyses** the parts with which it comes into contact. Acting on the nasal and laryngeal mucous membrane, it first slows the breathing, and also reflexly the pulse. As it passes down, it stimulates those branches of the vagus distributed to the lungs and heart, quickening respiration, and usually also circulation. As paresis of the vagus takes place, the respiratory movements

are sustained steadily, as in the third stage of anæsthesia. Still fuller effects paralyse the medullary centres, respiration becomes slower and feebler, and stops, while pulsation and blood-pressure are lowered, it may be, fatally; and this cardiac arrest is specially common in dogs. Dr Lauder Brunton states that "the nervous system is paralysed in the following order—first, the cerebral hemispheres; next, the grey matter of the cord; next, the white matter; next, the reflex power of the medulla oblongata; next, the automatic power of the respiratory centre; and, lastly, the cardiac ganglia" (*Pharmacology*).

Chloroform is **allied chemically** and **physiologically to alcohol** and various bodies of the alcohol series. It is more volatile, less stimulant, and more powerfully anæsthetic than alcohol. Compared with **ether,** about one-fourth of the dose causes more rapid anæsthesia; but some patients, especially dogs, are liable to suffer from the dangerous cardiac paresis occasionally induced by chloroform. **Chloral hydrate,** unless injected into the veins—a method of administration demanding special care and appliances—does not act promptly or effectually as an anæsthetic. **Butyl chloral hydrate** nearly resembles chloral hydrate, but exerts its anæsthesia specially on the fifth nerve and parts supplied by it (p. 328). **Methylene bichloride** ($C\,H_2\,Cl_2$), containing an atom more of H. and an atom less of Cl., causes more rapid anæsthesia than chloroform, but requires to be used in larger amount. The pure drug has the disadvantage of being costly, and that usually sold is stated to be a mixture of chloroform and alcohol. **Methylal** ($C\,H_2\,[O\,C\,H_3]_2$) has recently been introduced as an anæsthetic; acts quickly and effectually on dogs without apparent injurious after effects, and is also serviceable for local anæsthesia. **Iodoform** ($C\,H\,I_3$), besides acting as a local anæsthetic, is a powerful antiseptic and deodoriser, and a useful dressing for indolent wounds and fungous growths.

Toxic Effects.—Chloroform anæsthesia is attended with more risks in veterinary than in human patients. **Horses** chloroformed with due precautions, where three or four ounces of the drug are stated to have been administered, where the anæsthesia has not been continued for half-an-hour, and the operations performed have not been of a kind to produce serious

shock, have died apparently from respiratory arrest. Other horses, released from the hobbles, raised, and moved to their box, have staggered, fallen, and died, probably from cardiac arrest. Realising these dangers, few veterinarians anæsthise horses without informing their clients of the risks. As already indicated, **dogs** fully anæsthised by chloroform are more liable than horses to stoppage of the heart. Even in competent hands, the mortality is five, sometimes eight per cent. An ounce of chloroform rapidly swallowed by a dog fifteen pounds weight, or half an ounce injected into the pleural cavity, causes a sudden cry, gasping respiration, feeble pulsation, and death in one to three minutes. Similarly rapid fatal effects result when small animals are introduced into a large glass jar, containing seven per cent. of vapour (*Dr Anstie*, "*Stimulants and Narcotics*"). Notwithstanding its volatility, chloroform is stated to be discoverable in the bodies of dogs poisoned by its inhalation, even after remaining exposed for four weeks to summer heat (*C. Ludeking*, *Chemical News*, April 1887).

The chief **precautions** for the safe use of chloroform as an anæsthetic are—1. Its avoidance when the heart is weak or dilated, when, if anæsthesia is attempted, ether is preferred to or conjoined with it. 2. Administration of the vapour with about twenty parts of air; when too concentrated, it is liable to paralyse the heart; when too freely diluted, it produces undue excitement. 3. Painful or protracted operations are liable dangerously to lower cardiac action, and in such circumstances, and especially in dogs, the use of ether wholly or in part is essential. 4. To sustain the action of the heart, while diminishing risks of nausea and vomiting, easily digestible nutritive food should be given three or four hours previous to administration of the anæsthetic. If vomiting occurs, as it sometimes does in dogs and cats, care will be taken that vomited matters do not obstruct entrance of air; while, in this and in other cases, it is well to fix the tongue with dressing forceps, lest it fall back on the glotis. 5. When respiration becomes feeble or intermits, endeavour must be made to keep it up artificially. 6. When cardiac arrest has occurred, the head must be kept lower than the rest of the body, rough handling avoided, artificial respiration maintained, ether in-

jected in enemata, and amyl-nitrite given by inhalation or subcutaneously.

Medicinal Uses.—Chloroform is inhaled by horses and other animals to produce **anæsthesia** during castration, deep firing, and other painful operations (p. 47). Parturition among the lower animals is usually performed so easily, and with so little apparent pain, that chloroform, in the great majority of cases, is unnecessary. Where **false presentations** have to be rectified in the mare, it is sometimes, however, impossible, without anæsthesia, to keep the animal quiet, or to abate violent uterine throes; while in bitches it is also sometimes requisite when the pups have to be reduced in size before they can be extracted. Amongst cows and ewes, labour pains sometimes continue for hours, and other preparations for parturition appear to be complete; but the neck of the uterus remains firmly closed, sometimes in spite of medicines and manipulation. Chloroform inhaled in amount insufficient to produce complete anæsthesia, usually relaxes the rigid muscle. Partial anæsthesia generally controls labour pains occurring prematurely, moderates irregular tumultuous pains, such as are sometimes met with in first parturitions, and abates **after-pains**—the chloroform inhalation in some of these cases being aided by hypodermic injection of morphine.

Inhalation of chloroform has been advised for relaxing intestinal spasm and consequently aiding the **reduction of hernia** and strangulation of the bowels, but in horses the results have not been encouraging. It has been recommended in **tetanus** in horses, and relief is usually obtained so long as anæsthesia continues; but the temporary benefit is more than counterbalanced by the disturbed and excited state caused by the administration of the drug and by the excitement which succeeds the anæsthesia. Professor Robertson made repeated trials with chloroform in tetanus, and has recorded that, although spasms and muscular rigidity were abated while anæsthesia continued, they afterwards returned with increased severity (*Equine Medicine*). The shoeing of irritable and vicious horses is greatly facilitated if chloroform be given so as to produce partial anæsthesia. Inhaled or swallowed, it is occasionally prescribed to check the fits of **chorea** and **epilepsy** in dogs.

When **swallowed, it relieves gastric irritation** and pain, and also exerts antiseptic effects on the contents of the canal. Chronic irritability of the bowels in weakly foals or calves, after removal of the irritant by castor oil, is usually benefited by a dose of chloric ether and laudanum, repeated two or three times daily. Horses are subject to a form of **epizootic sore throat** and violent **spasmodic cough** which is notably relieved by chloroform or chloric ether, conjoined with belladonna extract or laudanum, dissolved in a pint of cold linseed gruel, and swallowed slowly, so as to ensure more prolonged anodyne effect on the irritable nerve-endings.

As **a local anæsthetic,** it has not such direct paralysing effects on sensory nerves as ether, cocaine, iodoform, or even as cold or carbolic acid. It is sometimes, however, applied to allay the pain of neuralgia, rheumatism, and occasionally of local inflammation. Its conjunction of anodyne and antiseptic properties have suggested its use, with carbolic acid and vaselin, in thrush and actinomycosis. Mixed with a little spirit, it is a cleanly means of destroying lice or fleas infesting small dogs or cats. As a liniment, it is sometimes useful in mammitis in cows. It is occasionally added to anodyne enemata for the relief of irritation of the lower bowels and urino-genital organs. Its high diffusion power, which it retains when mixed with spirit, renders it a useful vehicle for the subcutaneous injection of morphine, atropine, and other alkaloids. It is a solvent for gutta-percha, and the solution is occasionally employed as a substitute for collodion.

DOSES, ETC.—To produce anæsthesia in horses and cattle, f℥i. to f℥ij. are required; fʒiv. to f℥j. for sheep and pigs; fʒj. to fʒiv. for dogs. The fitting stage of anæsthesia is readily kept up by repeated small doses. **Administration** is best effected in small animals by saturating blotting-paper or a sponge, and holding it near the nostrils; and in the larger animals by placing the saturated sponge in one nostril, or in a nose-bag attached to the head (pp. 48-49). The horse to be anæsthised should always have his knees protected with stout caps. **Messrs Carlisle & Bell** of Carlisle have recently patented a convenient leather muzzle, in the bottom of which is a tin box with a perforated lid, in which the saturated sponge is

placed. The bag is nicely padded, and straps allow of its adjustment to fit any horse. Waste of the volatile liquid is accordingly so minimised that one ounce quickly anæsthises almost any horse. Indeed, Messrs Carlisle & Bell inform me that since they have used this muzzle they have anæsthised many horses with four drachms of chloroform, and, except in protracted operations, rarely use more than an ounce. If the operation to be undertaken necessitates the animal being cast, he is brought on to the bed prepared for him, and usually within three minutes may be carefully pulled over and secured. The chloroform vapour being inhaled in tolerably concentrated form, the initial stage of excitement is shortened; the reduced quantity required diminishes risk of cardiac paralysis; while the nausea and depression ensuing from the use of larger doses are avoided.

The Medico-Chirurgical Society, in 1864, recommended as the **safest anæsthetic mixture** for human patients, two parts of chloroform, three of ether, and one of rectified spirit; and this is now known as the A. C. E. Mixture. The Austrian Government more recently advised one part of chloroform and six parts of ether in cold weather, and eight parts of ether in warm weather. These mixtures, although their constituents have the disadvantage of evaporating unequally, are the best anæsthetics for veterinary or for human practice. The subcutaneous injection of morphine, fifteen or twenty minutes before casting and anæsthising a horse, facilitates and intensifies the anæsthesia. The respiration, pulse, and reflex sensibility of the conjunctiva must throughout be carefully watched. If undue effects be produced, the inhalation must be immediately stopped, free access of fresh air allowed, water thrown over the head and neck, the tongue drawn forward, and artificial respiration at once adopted.

Administered by the mouth as a stimulant, antispasmodic, and anodyne, the dose for horses or cattle is f℥i. to f℥ij; for sheep and swine, ♏xx. to ♏xl.; and for dogs, ♏v. to ♏x. These doses are given with syrup, mucilage, whisked egg, or weak spirit, and repeated at intervals of two or three hours.

AQUA-CHLOROFORMI, prepared with 1 part to 200 of water, is

used as a carminative and stimulant, a convenient medium for giving unpalatable drugs, and as an antiseptic.

Spirit of Chloroform, also called chloric ether, is made by dissolving one fluid part of chloroform in nineteen fluid parts of rectified spirit. It has the specific gravity ·871, and a warm ethereal odour and taste. It is an effectual **stimulant, antispasmodic, and anodyne,** resembling ether and sweet spirit of nitre. Diluted with water, or any bland cold fluid, it is prescribed for horses in doses of f℥i.; for cattle, f℥ij.; for sheep and pigs, fʒij. to fʒvi; and for dogs, fʒi. to fʒij.

Chlorodyne, so popular an anodyne in human medicine, is made from different formulæ; Dr Collis Browne's is stated to contain ten parts each of chloroform, ether, Indian hemp, and morphine; two parts capsicum tincture and prussic acid; three parts aconite and hyoscyamus tinctures; one part of oil of peppermint; five parts hydrochloric acid, and fifty of simple syrup (*New Remedies*, October 1877). It is an effectual anodyne and antispasmodic frequently prescribed to relieve especially gastro-intestinal and bronchial irritation.

CINCHONA.

Bark of different species of Chinchona. *Nat. Ord.*—Cinchonaceæ.

The evergreen trees or tall shrubs, which yield the medicinal barks, were originally grown on the slopes and in the valleys of the Andes, but are now cultivated in British India, Ceylon, Java, and Jamaica. The bark, in 1639, was brought from Peru to Madrid, distributed by the Jesuits, and hence received the names of Peruvian and Jesuits' bark. Of thirty-six known species, there are many varieties, yielding barks distinguished as pale, yellow, and red.

The pale cinchonas, some of which are got from the stem and branches of the Cinchona officinalis and C. Condaminea, are usually in single and double rolls, and yield more cinchonine than quinine.

The yellow barks yielded by the C. Calisaya and other species are commonly met with in flat pieces, eight to fifteen

inches long, two to three wide, and two to four lines thick. They consist mostly of liber; are furrowed and brownish-yellow externally; fibrous and yellow-orange within. The transverse fracture shows numerous short fibres; the powder is cinnamon-brown; the odour aromatic; the taste bitter, without astringency. Good specimens yield five to six per cent. of quinine.

The red barks are frequently the produce of the C. succirubra; are sometimes in quills, but usually in flat, in-curved pieces, six to fifteen inches long, one to three inches wide, two to three lines thick, and made up chiefly of liber. They are red, rough, wrinkled, and coated with epiderm externally; finely fibrous, with granular fracture, and brick-red or deep red-brown internally; agreeable in odour, and of a bitter, rather astringent taste. They yield five to six per cent. of alkaloids.

The cuprea barks, from the Remijia—a genus nearly allied to cinchona and cascarilla—are now largely imported; are dense, with a thin, longitudinally-striated epidermis, and a smooth pale-red inner-surface; and besides quinine and quinidine, contain a special alkaloid cinchonamine, but no cinchonidine (*Phillips*).

PROPERTIES.—The cinchona barks occur **in quills,** stripped from the smaller branches, and curled into single or double rolls, and in **flat pieces** from the larger branches or stem. They are dried in the sun, or on hurdles over fires. Their colour varies from deep-yellow to red-brown, and is deepened by moisture. They have an aromatic odour, and a bitter, usually astringent taste. They are soluble in cold and hot water, and in alcohol; their best solvents are proof-spirit and diluted acids. When solutions are exposed to high or prolonged heat, the colouring matter unites with the alkaloids, forming insoluble compounds, and on this account decoctions and extracts are ineligible. The alkaloids, their salts, and any bark containing them, when heated in a test-tube, produce a very characteristic purple tar. The tests of quality and value are the general appearance, fracture, colour, odour, taste, and percentage of the alkaloids, which are the active principles.

COMPOSITION.—Besides ordinary plant constituents—lignin,

starch, gum, resin, mineral matters, with traces of a volatile oil—cinchona bark, contains (1) a series of active alkaloids ranging from three to five per cent.; (2) kinic and kinovic acids, with which the alkaloids are naturally united, but which have no very marked physiological actions; (3) tannins, recognised as kino-tannic acid and kinovi-tannic acid, constituting two to four per cent. of the bark, and conferring its astringency; (4) a resinous amorphous neutral body, kinovin; (5) a colouriug matter, cinchona red.

QUININE ($C_{20} H_{24} N_2 O_2$) is present in all the Cinchona and Ramijia barks, and is prepared by boiling the bruised bark with diluted hydrochloric acid, and mixing the filtered solution with lime until it is alkaline, when a precipitate falls, containing the several alkaloids and colouring matters, is collected and boiled with alcohol, which dissolves both the quinine and cinchonine. The solution is neutralised with sulphuric acid, boiled with animal charcoal, and filtered; when, on standing, the quinine sulphate crystallises out, leaving the chinchonine sulphate in solution. It is in the form of sulphate that quinine is generally prescribed in this country. From a watery solution of the sulphate, the alkaloid may be precipitated by ammonia. It occurs in delicate silky prisms containing 3 Aq. It has an intensely bitter taste. It requires for solution 900 parts of cold water, but is readily soluble in alcohol, ether, chloroform, and diluted acids. It forms colourless, bitter, crystallisable, rather insoluble salts, remarkable, like the alkaloid, for tonic and febrifuge properties. Quinine and its salts turn a ray of polarised light to the left. Aqueous solutions, acidulated with sulphuric acid, even when extremely diluted, exhibit blue fluorescence. Treated with chlorine or bromine solutions, and then with a drop of liquor ammoniæ, a green coloration is produced.

QUINOIDINE, or amorphous quinine, is obtained from the brown mother-liquor from which the quinine sulphate is crystallised, and usually contains quinidine, and also cinchonine and cinchonidine. It is isomeric with quinine, is believed to be nearly as active, is considerably cheaper, and deserves the attention of veterinarians.

QUINIDINE, or conquinine, is isomeric with quinine, but con-

tains two instead of three molecules of water, crystallises in larger prisms, is dextro-rotatory, and its salts are more soluble and of nearly the same activity. It is got from quinoidine, and also from some of the inferior cinchona barks.

CINCHONINE ($C_{20} H_{24} N_2 O$) is present in the bark of various species of Cinchona and Ramijia. It is obtained from the mother-liquors after crystallisation of sulphate of quinine, by precipitating the alkaloid with caustic soda, freeing it from other alkaloids by washing with spirit, dissolving in sulphuric acid, purifying with animal charcoal, and crystallising. Like the quinine, it is used in the form of sulphate, which occurs in hard, colourless prisms, having a feebly bitter taste. It is anhydrous, dextro-rotatory; soluble in alcohol, ether, and thirty parts of water; its acidulated watery solution exhibits no fluorescence. Chlorine and ammonia solutions, instead of the emerald green produced with quinine, give a yellow-brown. It is the least active of the cinchona alkaloids, requiring to be given in double the dose of quinine.

CINCHONIDINE, an alkaloid isomeric with cinchonine, is obtained from the mother-liquors of the crystallisation of sulphate of quinine, is purified by crystallisation from alcohol, and finally from hot water—B. P. Like the other alkaloids, it is used as a sulphate, and is considerably more active than cinchonine.

Quinine and cinchonine, when heated with excess of a mineral acid, are each converted into an amorphous isomeric alkaloid, termed respectively quinicine and cinchonicine.

ACTIONS AND USES.—Cinchona bark and its alkaloids, in excessive doses, produce nausea, giddiness, and delirium—a train of phenomena recognised as cinchonism, but rarely seen amongst the lower animals. Medicinal doses are antiseptic, stomachic, tonic, and febrifuge. The astringency of the crude bark depends mainly upon its acids and tannins, but its special tonic and febrifuge properties are due to its alkaloids.

GENERAL ACTIONS.—The cinchona alkaloids differ only in the degree of their action, and quinine, the most active, may be taken as the type of all. It has **antiseptic** properties nearly as marked as those of boric, carbolic, benzoic, and salicylic acids, camphor, eucalyptol, and chloral hydrate. 1 part to

830 hinders, 1 part to 625 prevents, development of anthrax bacilli (*Koch*). It diminishes fermentation, especially when depending upon such organised ferments as the alcoholic, lactic, or butyric. It checks oxidation, and lessens protoplasmic and amœboid movements. Similar antiseptic effects doubtless occur when quinine is administered, and afford explanation of most of its curative effects.

It is absorbed from mucous and cellular surfaces, especially when in perfect solution. Its bitterness reflexly increases the flow of saliva. Small or moderate doses **stimulate the stomach** and **increase appetite ;** but large doses impair appetite, and may induce nausea and vomiting. Its effects on intestinal secretion and movements are unknown ; but it does not increase secretion of bile. Absorbed into the blood, full doses **lessen the contractility and movements of the white blood corpuscles,** and cause contraction of the spleen. It increases the size of the red blood corpuscles, but diminishes their capacity to give up oxygen. Small and moderate doses increase the strength of the circulation, but large doses weaken cardiac action, paralyse the vaso-motor centre, and diminish blood-pressure. Large doses paralyse the vagus nerve. Moderate doses quicken respiration ; large doses slow and eventually paralyse it. Moderate doses diminish tissue-change. The amount of oxygen taken up, and of carbonic acid exhaled, are alike diminished ; in fever, especially depending upon septic poisoning, temperature is reduced. Increased tone is imparted to the nervous system by moderate doses, but large doses disturb and depress nervous centres. Sensory and motor nerves are affected only when the drug is locally applied. It does not, as has been supposed, cause contraction of the uterus or excite abortion : this has recently been confirmed by Dr H. C. Wood's experiments on healthy pregnant cats (*Practitioner*, 1879 and 1881). It is excreted by the kidneys, stimulating the urino-genital tract, and may be discovered in the urine half-an-hour after its administration (*Dr Brunton*).

Cinchona bark, as a bittter tonic, **resembles** cascarilla bark (p. 315), calumba root, and hydrastis, the rhizome and rootlets of Hydrastis canadensis or golden seal, which yields the alkaloids berberine and hydrastine. The antiseptic and febrifuge properties

of quinine ally it to hydroquinone, kairin, antifebrin (pp. 271 and 273), salicylic acid, and eucalyptol; while the antiperiodic actions resemble those of arsenic..

MEDICINAL USES.—The bark and its alkaloids are prescribed for all classes of patients as a **bitter stomachic** and **tonic.** They improve appetite, check abnormal gastro-intestinal fermentation, and counteract relaxed conditions of the intestine and accumulations of mucus, which prove favourable to the development of worms. In troublesome cases of **atonic indigestion** in horses, where alkaline treatment failed, the late Professor Robertson frequently gave 20 to 30 grs. of quinine sulphate, with half a drachm to a drachm of nitric or hydrochloric acid. Weakly foals and calves affected by **relaxed bowels** after a dose of oil are often much benefited by a few doses of cinchona bark, hydrochloric acid, and spirit. Few tonics are so effectual as bark or quinine in improving appetite and muscular strength, and **hastening convalescence** from debilitating disease. In **anæmia** they are advantageously joined with iron salts. They are serviceable in the earlier stages of tuberculosis, in septicæmia, and pyæmia in all animals; in influenza, protracted cases of strangles, purpura, and other typhoid attacks in horses; in puerperal metritis in cows and ewes; and in bad cases of distemper in dogs—their beneficial effects in these and other cases probably depending on their **attacking** and **destroying pernicious micro-organisms.** Drachm doses, conjoined with iron salts, repeated night and morning, are certainly the most effectual treatment for **purpura.** In **malarial diseases,** which in various regions attack the lower animals as well as man, no remedies prove such effectual febrifuges. Not only do they mitigate the febrile symptoms and cut short the fever attack, but full doses, given one or two hours before a periodical seizure, will frequently prevent it. The antiseptic properties of the drug best explain this remarkable power. Mr R. W. Burke, of the Army Veterinary Department, has successfully used drachm doses of quinine in malarial and other fevers affecting horses and cattle in India, and where febrile symptoms run high, reports that the medicine, within an hour after administration, reduces the temperature 1° to 3°, and when persisted with prevents its subsequent

rise (*Veterinarian*, October 1887). It is often useful in **rheumatism,** being given either by the mouth or hypodermically, frequently conjoined with salicylic acid or potassium iodide. Mr T. A. Dollar, New Bond Street, London, has successfully treated **rheumatism** and **sciatica** in horses, which have resisted other remedies, by hypodermic injection into the affected muscles of half a drachm of quinine sulphate in solution, and has not found undue irritation or abscess follow the operation. Like other bitters, when administered with cathartics, it generally increases their activity. Alternated with cod liver oil and iron, quinine is the **best tonic for weakly dogs** and those suffering from chorea.

Both bark and alkaloids are occasionally used as antiseptics for wounds, and as a spray and gargle for relaxed and diphtheritic throats.

DOSES, ETC.—Cinchona bark is prescribed in the following doses: for horses, ʒij. to ʒiv.; for cattle, ℥i. to ℥ij.; for sheep and pigs, ʒi. to ʒiv.; for dogs, grs. xx. to ʒi.; repeated twice or thrice daily for several days. If nausea or vomiting supervene, as occasionally happens in dogs, the dose should be considerably reduced, or intermitted for a day or two. It is administered in bolus, pill, or solution, and is often conjoined with camphor, gentian, ginger, spirit, or ether. The **infusion** is made by digesting for one hour, in a covered vessel, one part red bark in No. 40 powder with $\frac{1}{4}$ part aromatic sulphuric acid and twenty parts water, and straining. The **tincture** is made by maceration and percolation of four ounces red bark No. 40 powder in one pint of proof spirit.

The alkaloids are used in the following forms. Several of the salts of quinine, being more soluble, are preferred to the alkaloid. **Quinine sulphate** or disulphate—$(C_{20}H_{24}N_2O_2)_2.H_2SO_4.15Aq.$—is the form generally used in Great Britain. Although requiring 700 to 800 parts of water for solution, it is very readily dissolved in water acidulated by sulphuric acid. **Quinine bisulphate,** commonly used in America, is soluble in ten parts of water. **The hydrochlorate,** much used in Germany, is also soluble, and less liable to be spoilt by the fungus which injures other quinine solutions.

These salts of quinine, as also the sulphate of quinoidine

(p. 340), and sulphate of cinchonidine (p. 341), as already stated, do not differ materially in activity, and are prescribed in the following doses:—Horses and cattle, grs. xx. to ʒi.; sheep and pigs, grs. v. to grs. xx.; dogs and cats, gr. j. to grs. viij. Cinchonine sulphate is given in double these quantities. These doses, in bolus, pill, or solution, are administered two or three times daily. When given in the fluid form, their solubility is increased and their bitterness diminished by prescribing them in an acidulated solution. They are also conveniently exhibited in milk. For hypodermic use a convenient solution of the sulphate is made with tartaric acid. Any tendency to nausea or vomiting is abated by combination with hydrobromic acid. As these alkaloids form comparatively insoluble compounds with bile, any excess of it before their administration should be cleared away by a laxative. They are often conjoined with other bitter tonics, with capsicum, camphor, valerian, or salts of iron. The citrate of iron and quinine is sometimes used in canine practice; but as it is apt to be adulterated, it is better to prescribe a reliable quinine salt with a salt of iron.

CINNAMON.

CINNAMOMI CORTEX—Cinnamon bark. The dried inner bark of shoots from the truncated stocks or stools of the cultivated cinnamon tree (Cinnamomum zeylanicum). Imported from Ceylon, and distinguished in commerce as Ceylon cinnamon. B. P.

CINNAMOMUM OLEUM. The oil distilled from cinnamon bark. B. P. *Nat. Ord.*—Lauraceæ.

The bark occurs in rolled quills, is thin and brittle, yellow brown externally, darker brown on its inner surface, with a fragrant odour, and a warm, sweet aromatic taste. Besides mannite, resin, and other vegetable constituents, the bark contains tannic and cinnamic acids, but its aroma and medicinal properties depend upon the presence of about one per cent. of a **volatile oil** (C_9 H_7 O H), which, when recent, is bright yellow, but becomes cherry red when kept. An inferior oil is extracted from the leaves.

Actions and Uses.—Cinnamon **bark** is aromatic, carminative, and astringent, and is used for flavouring.

The oil resembles that of anise, caraway, coriander, peppermint, and other Umbelliferæ and Labiatæ (pp. 187, 221). It is a carminative stimulant and antispasmodic, useful in all animals in indigestion, flatulence, and diarrhœa. Mr Richard W. Burke, Army Medical Department, thus testifies to its merits: "After a long trial I have found there is no more efficacious remedy in the treatment of diarrhœa in the dog, especially in that form of the disease which is noticed during the rains in India. It will check diarrhœa when opium, chlorodyne, and other remedies usually employed have been found to produce no effect in allaying the symptoms. I have also employed the tincture of cinnamon, which is prepared by dissolving the bark in rectified spirits and straining, in doses of one to two drachms for smaller animals. It is nearly if not equally as rapid in its effects as the oil of cinnamon bark" (*Veterinarian*, February 1888).

Doses, etc.—Of the bark horses take ʒiv. to ℥i.; dogs, ʒ½ to ʒi. Of the oil horses take ♏xx. to fʒi.; dogs, ♏i. to ♏iv., administered on sugar, or in syrup, mucilage, or spirit and water.

COCAINE.

Cocainæ Hydrochloras. The hydrochlorate of an alkaloid obtained from the dried leaves of the Erythroxylon Coca, a shrubby plant indigenous to the mountains of Peru and Bolivia. $C_{17} H_{21} N O_4 . HCl$. *Nat. Ord.*—Lineæ.

The alkaloid of which the leaves yield 26 per cent., is prepared by agitating an acidulated alcoholic extract with ether. It occurs in colourless prisms, requiring for solution 704 parts of water. The hydrochlorate, in almost colourless acicular crystals, or crystalline powder, is readily soluble in water and alcohol. Its watery solution has a bitter taste, producing on the tongue a sensation of tingling, followed by numbness. It gives a yellow precipitate with gold chloride, and a white precipitate with ammonium carbonate, soluble in excess of the

re-agent. Cocaine is associated in the plant with cocatannic acid, and with other two alkaloids—ecgonine and hygrina—and a volatile constituent which gives aromatic fragrance to the fresh leaves.

ACTIONS AND USES.—Cocaine paralyses the sensory nerves with which it comes in contact, and is thus **a local anæsthetic.** It is also an **antiseptic.** Administered internally, small or moderate doses are **stimulant** and **tonic.** It lessens fatigue. The South American Indians on long marches, not only chew the leaves, but give them to their horses, with the effect of diminishing thirst, hunger, and the sense of fatigue. Large doses paralyse nerve-centres, appear to act specially on the semi-circular canals, and produce in dogs and other animals constant movements of the head, diminished power of co-ordination and equilibrium, rotatory convulsions, and episthotonos, with death by paralysis of respiration. On respiration, circulation, on the pupil, and on secretion of sweat and saliva, its effects resemble those of atropine. It is excreted by the kidneys; does not appear, however, to influence the proportion of the urinary constituents, but exerts antiseptic effects on the urine and other excretions.

MEDICINAL USES.—Cocaine hydrochlorate is a most convenient and effectual local anæsthetic, its cost alone preventing its extensive use in veterinary practice. Its effects are confined to the skin or mucous surface moistened with it; are more easily regulated than those of ether spray, are unaccompanied by pain, and may be kept up for a long period without injuriously affecting the nutrition of the parts. Anæsthesia may be produced within five minutes, and usually passes away within twenty to thirty minutes. Twenty minims of a four or five per cent. solution dropped into **the eye,** within ten minutes, diminish sensibility sufficiently for a very thorough examination, for lessening irritability and pain in cases of conjunctivitis, ophthalmia, and ulcerations of the cornea; for removal of chaff or other foreign bodies embedded in the cornea; for excision of warts; for stitching torn eyelids, or for treatment of other injuries of the eye. Indeed, after several applications of the cocaine solution, the eyeball of the horse has been removed, apparently without suffering, and without the necessity of cast-

ing the patient. Professor Walley records that it is more valuable than any other remedy in retinitis; and many practitioners, in order to allay hyperæsthesia, add a few drops of cocaine solution to astringent, and other applications used for the eyes.

In examinations and operations in connection with the **larynx,** cocaine is equally serviceable, and for such cases a ten to twenty per cent. solution is generally used. Applied to the skin, along the course of the plantar nerves, and still more effectually when injected subcutaneously, it abolishes sensibility sufficiently for the painless performance of neurotomy on most horses without casting them. Mr Richard Rutherford, Edinburgh, after closely clipping or shaving the hair, finds that half-an-ounce of a twenty per cent. solution, in fifteen or twenty minutes, anæsthises the limbs even of irritable horses sufficiently for the performance of firing without casting, and for the painless insertion of setons in lameness of the back tendons and hock. It is serviceable in the opening of abscesses, the removal of tumours, and in various operations on the uterus vagina and rectum. Subcutaneously injected, it has been used to allay rheumatic and other irritative pain. In order to preserve cocaine hydrochlorate solutions, which, when long kept, are liable to spoil, 1-200th part of boric acid should, when they are made, be added to them.

COD-LIVER OIL.

OLEUM MORRHUÆ. The oil extracted from the fresh liver of Gadus morrhua, by the application of a heat not exceeding 180° F.—B. P.

The fresh, carefully-cleaned livers of cod, and occasionally of other fish, are placed in a boiler and exposed to steam heat not exceeding 180° F.; twenty-eight pounds of liver yield ten pounds of oil, which floats to the top, is collected and filtered, cooled to 50° F., and again filtered. The chief supplies come from Newfoundland. An oil called candle-oil, prized by the Indians as a tonic, and used along the Pacific Coasts, is obtained from the oslachan or boulican which inhabits the waters of British Columbia and Vancouver's Island. Good samples

of cod-liver oil have a pale yellow colour, and an oily, fishy taste, which becomes, however, less obvious to those accustomed to take it. The dark colour and nauseous flavour of indifferent specimens result from exposure to high temperatures, or from the oil being extracted from stale, putrid livers. Its specific gravity is about ·920; ether dissolves it readily; cold alcohol dissolves two to three per cent.; hot alcohol, three to seven per cent. It consists of varying proportions of **palmatin and stearin**; seven per cent. **triolin**; a dark-brown, tasteless, inodorous body **gaduin**; other **biliary matters**; phosphorus, iodine, bromine, and chlorine, with phosphoric and sulphuric acids, lime, magnesia, and soda. A drop of sulphuric acid, added to a few drops of cod-liver oil in a porcelain cup, develops a violet colour, which passes to yellow or brown-red, depends upon the presence of biliary matters, and indicates the source but not the purity or goodness of the oil.

Actions and Uses.—Cod-liver oil is nutrient, tonic, and alterative. Like other fixed oils, large doses cause derangement of the bowels and purgation. For lubricant purposes, vegetable and mineral oils are more convenient and less liable to rancidity.

Dr Pollock published in the *Lancet* (5th November 1853) some interesting **experiments** on cod-liver oil, made by an Essex agriculturist, on **pigs, sheep, and cattle.** Twenty pigs, separated from a lot of three hundred, averaging from five to fifteen stones, received two ounces of oil daily, with as much meal as they cleared up. The rest of the lot were treated in exactly the same manner, but got no oil. Those receiving the oil are stated to have consumed less food, and when killed "weighed the heaviest, and made the most money in the London market, the fat being firm and white. When the daily allowance of oil was increased to four ounces per day, the fat became yellow, and the flesh acquired a fishy taste." For small pigs, an ounce daily was found the most economical quantity. An ounce given daily to sheep improved the quality both of the fat and flesh; while cattle receiving about half a pint daily are stated to have eaten less food, and paid better, than when treated in the usual way. The oil, it is mentioned, cost from 2s. 8d. to 3s. per gallon; and in some comparative

experiments is said to have proved superior to sperm oil. These experiments deserve to be repeated; they confirm the well-recognised fact that oleaginous materials are essential to speedy and economical fattening; they do not, however, suffice to establish the individual superiority of cod-liver oil. In healthy animals, equally satisfactory results would probably be obtained from the use of linseed, lard, rape, or other mild fixed oil.

Medicinal Uses.—The biliary constituents of cod-liver oil facilitate, however, its digestion. Admixture of a little bile is found by experiment to hasten absorption of oil included in a loop of intestine. Cod-liver oil also appears to be more readily oxidised than most other oils. This **ready absorption and assimilation** render it specially useful not only for children, but for other young animals, in cases of **malnutrition** and convalescence from exhausting disease. It improves general nutrition, although it has no specific action on any particular organ. Two-ounce doses, given twice daily, I have found benefit delicate **horses, thriving badly** after strangles and influenza. "In chronic **catarrh and bronchitis,** it appears to furnish suitable material for the formation of mucous cells and the repair of the inflamed mucous membrane" (*Brunton*). Like other oils, it materially relieves horses suffering from **broken wind.** It helps recovery of **cattle** reduced by diarrhœa, anæmia, or rheumatism; although for many such cases in horses, cattle, and sheep, it is superseded by linseed or oil cakes. For **dogs and cats** it is particularly useful in protracted cases of distemper, eczema, and other inveterate skin diseases; in epilepsy, chorea, rickets, and in chronic rheumatism, especially that variety known as kennel lameness, and depending upon damp, bad feeding, and faulty nutrition.

Doses, etc.—Horses take f℥ij.; cattle, f℥ij. to f℥iv;; sheep about f℥j.; pigs, fʒiv. to f℥i.; dogs, fʒi. to fʒiv.; cats about fʒi. The doses may be repeated twice a day, and persevered with, if required, for weeks; if diarrhœa is induced, they must be reduced or intermitted for a day or two. To remove disagreeable flavour, and prevent nausea or vomiting, it is given in milk, mucilage, or gruel, beat up with an egg, conjoined with some aromatic, or with ether, and is best digested along with or immediately after other food.

COLCHICUM.

Autumn Crocus. Meadow Saffron. The fresh corm of Colchicum autumnale. Collected about the end of June or beginning of July; and the same stripped of its coats, sliced transversely, and dried at a temperature not exceeding 150° F. B.P. *Nat. Ord.*—Colchicaceæ or Melanthaceæ.

The autumn crocus grows wild throughout middle and southern Europe and on English lawns and coarse wet pastures, in mild moist localities, and is cultivated in many gardens. It has an annual stem; lilac or purple flowers, numerous round, red-brown, bitter, acrid seeds, about the size of millet; and a biennial root, which, towards June, and when about a year old, produces near its lower end a small bulb. This offshoot gradually increases in size, sends up in autumn a flowering stem, and in spring the familiar crocus leaves with the seed vessel. Early in July it attains its full growth, being about the size of a walnut, and beginning in its turn to form a young bulb. At this period the B. P. directs their collection; but Flückiger and Hanbury believe that the medicinal activity and keeping properties alike improve for several weeks, and that the plant should not be taken up until it reaches inflorescence.

The sliced corms are kidney-shaped, about one and-a-half inches long, and an inch wide, are greyish-white, dry, firm, and starchy, with a bitter acrid taste. They yield their active principles to spirits and vinegar. They contain about seventy per cent. of water, ten of starch and gum, with a bitter, crystallisable, poisonous alkaloid, called **Colchicine** ($C_{17}\ H_{19}\ N\ O_5$), conjoined with gallic acid, present also in other parts of the plant, and nearly 100 times more active than the fresh bulb. Sulphuric acid colours it yellow-brown, nitric acid dyes it violet, passing through various hues to yellow. They also contain traces of the allied alkaloid veratrine.

Actions and Uses.—Colchicum in large doses is a gastro-intestinal irritant; medicinal doses are emetic, cathartic, and chologogue; its diuretic and diaphoretic actions are uncertain.

It resembles the other Melanthaceæ—Veratrum album, V. viride and cevadilla.

Toxic Effects.—The corm, whether used green or dry, the seed, any active preparation thereof, and still more notably the colchicine **irritate** the skin and mucous surfaces. Full doses cause reflex flow of saliva, irritation of the fauces, **gastro-intestinal irritation,** with loss of appetite, flatulence, diarrhœa, and slowing of the pulse. A poisonous dose, or more moderate frequently repeated doses, produce acute gastro-enteritis, vomiting, purging, and **collapse,** with small, quick, thready pulse, this effect on the circulation depending mainly upon reflex action. The brain, motor nerves, and muscles are unaffected; the spinal cord and sensory nerves are paralysed.

Mr Broad, of Bath, in the *Veterinarian* for April 1856, records two cases of **horses dying** from eating in their hay the stalks, leaves, and seeds of colchicum. Colic, tympanitis, and great dulness supervened, with death in twenty-four hours; and on post-morten examination, " inflammation and patches of erosion " were found on the mucous membrane of the stomach. Mr Broad also mentions the poisoning of eight two-year-old in-calf heifers, which suffered from tympanitis, purging, feeble pulse, and coma. Three died in about twenty hours, and the mucous membrane of the stomachs exhibited patches of inflammation and erosion.

M. Barry, in the *Recueil de Médecine Vétérinaire* for December 1862, records the case of a **cow and heifer** in Aisne, which ate some cut grass containing a considerable amount of meadow saffron. In a few hours they had violent colic, profuse and bloody diarrhœa, tenderness of the abdomen, coldness of the surface, and prostration. The cow recovered; the heifer died from irritation and exhaustion in three days. A number of cows ate small quantities of colchicum, suffered from colic and diarrhœa, but recovered when treated with emollient drenches and mild saline mixtures. In the *Veterinarian* for August 1864, three cattle eating colchicum are reported to have shown dulness, stupor, grinding of the teeth, dilated pupils, imperceptible pulse, relaxed bowels, cold extremities, and thirst, but no griping pains, nor quickened breathing. They were successfully treated by laxatives and stimulants.

Dogs and cats, like man, are even more susceptible than horses or ruminants. Two drachms of the dried bulb caused in dogs vomiting, bloody evacuations, diuresis, tremors of the limbs, depression of the action of the heart, and death in five hours. A tenth of a grain of colchicine given to a cat occasioned salivation, vomiting, purging, staggering, extreme languor, colic, and death in twelve hours. Rabbits, as well as frogs and other cold-blooded animals, are stated to be less susceptible to the drug.

As antidotes the stomach must be emptied; full doses of tannic acid form an insoluble compound with the colchicine; white of egg and other demulcents are freely given, and stimulants if there be collapse.

MEDICINAL USES.—Large doses of the fresh corm given by Professor Rutherford to fasting dogs, and their expulsion by vomiting prevented, were found to increase secretion of bile, and also to purge powerfully. But action on the liver and gastro-intestinal membrane is more safely effected by other medicines. Small doses, conjoined with alkalies or salines, are occasionally given to horses in **rheumatism and rheumatic influenza,** especially in subacute cases in which inflammation flies from joint to joint. Foreign authorities prescribe it in constitutional ophthalmia. Professor Williams has used it, conjoined with potassium iodide, in **pleurisy,** in rheumatic forms of pericarditis, and sometimes in pneumonia when the kidneys were torpid. But although colchicum is excreted in considerable amount by the kidneys, it does not with much certainty increase either their watery or solid parts.

DOSES, ETC.—The powdered corm or seed for horses, ʒss. to ʒj.; for cattle, ʒj. to ʒij.; for sheep, grs. x. to grs. xxv.; for dogs and pigs, grs. ij. to grs. viij., given with salines. A convenient solution is made with one part of colchicum, six or eight of vinegar, and a little spirit.

COPPER AND ITS MEDICINAL SALTS.

Copper (Cu) is a brilliant red metal, found native near Lake Superior in North America, crystallised in octahedrons or cubes. It has a spec. grav. of 8·95, a nauseous styptic taste, and an

unpleasant odour, especially when rubbed. It is malleable and ductile, constitutes 95 per cent. of the material of our bronze coinage, which contains besides about four of tin and one of zinc. Brass consists of about two-thirds of copper and one-third of zinc. The principal copper ores are pyrites, which is a double sulphide of copper and iron, and the carbonate or malachite. Its chief officinal salts are the sulphate, nitrate iodide, and acetate. Copper forms two series of salts, the cupric containing one, the cuprous two, atoms of copper. The cupric salts are the most stable, and, when hydrated, have a green or blue colour.

Cupric salts are recognised by the following **tests.** Addition of hydrochloric acid gives no precipitate. In the acidulated solution hydrogen sulphide and ammonium hydrosulphide give black precipitates of copper sulphide (CuS); solutions of potassium or sodium hydrate a greenish-blue precipitate of cupric hydrate ($CuO. H_2O$), insoluble in excess, but blackened by heat; ammonia, a similar precipitate, which redissolves on further addition of the precipitant, forming a deep blue liquid, yielding $Cu\ SO_4.\ 4NH_3.\ H_2O$; and potassium ferrocyanide, a maroon-red precipitate of copper ferrocyanide, $Cu_2\ Fcy$. A piece of polished iron or steel, placed in a solution of a copper salt, quickly becomes coated with a red deposit of metallic copper.

Actions and Uses.—Salts of copper, like those of other heavy metals, form sparingly soluble albuminates. In virtue of their combining with the albumin of the tissues, and according to the strength of the application, they are antiseptic, astringent, irritant, or caustic. When they are absorbed, these topical effects are more widely extended, and more general astringent, antiseptic, tonic, or irritant effects are produced.

Salts of copper especially **resemble** those of **zinc** and **silver,** and in many of their actions are also allied to those of iron, lead, and mercury. The sulphate, nitrate, and other soluble salts, have no action on the unbroken skin, but **combine with albumin,** and hence exert astringent and irritant effects on mucous surfaces. When swallowed, they **irritate the stomach,** in many animals producing emesis, which, when the drug is absorbed, is also excited by irritation of the vomiting centre. After exerting, according to dose or state of concentration,

astringent or irritant effects on the alimentary mucous membrane, they are slowly **absorbed as albuminates,** and as the still more soluble peptonates. They appear to remain in the plasma of the blood, but are not combined with the corpuscles or only to a limited extent. They probably unite with various tissues, and **modify** their **nutritive and functional activity.** Like other metallic salts, they are **excreted** tolerably quickly, chiefly by the bile, by the mucous membranes of the stomach and bowels, to a slight extent by the skin, mainly by the kidneys, and exert their special effects on the excreting channels.

Copper in the metallic state is devoid of poisonous action. Drouard gave ounce doses finely divided to dogs of different sizes and ages, but none experienced any inconvenience (*Pereira*). Two drachms of oxide caused in dogs vomiting and diarrhœa. The more **soluble salts** are more **active irritants.** Dogs tolerate for a week or two daily doses of 10 to 15 grains of the sulphate or acetate, but 40 to 60 grains induce loathing of food, diarrhœa, and in some instances death by collapse. **Chronic poisoning** occasionally occurs among animals depastured in the neighbourhood of copper-smelting works, but such effects are apt in part to depend upon the arsenic present in these ores (p. 243). Cuprous poisoning also results in cows, pigs, and dogs, from the use of food or drink which has become impregnated from being boiled in copper vessels, and allowed to remain in them while cooling. Acid and fatty matters are most apt thus to be contaminated, especially if long in contact with copper, and exposed at the same time to air and moisture. The prominent **symptoms** are impaired appetite, constipation, imperfect nutrition, muscular weakness, and occasionally hæmoglobinuria or hæmaturia. **The antidotes** consist of white of egg, washing out the stomach, administering demulcents, and allaying irritation and pain, if need be, by morphine.

COPPER SULPHATE. Cupri Sulphas. Cupric Sulphate. Blue Vitriol. Blue Stone. Vitriol of Copper. $Cu\ SO_4.\ 5H_2O$.

Copper sulphate is got by dissolving the black oxide in sulphuric acid, by boiling metallic copper with sulphuric acid, and

on the large scale by roasting copper pyrites ($Cu\ Fe\ S_2$), when both the copper and iron are oxidised into sulphates ; at the red heat used the iron sulphate is decomposed, and the copper sulphate crystallised from a hot watery solution. Blue vitriol made from pyrites always contains iron, which does not, however, interfere with its medicinal uses. It occurs in large blue double oblique rhombic prisms, has a spec. grav. of 2·2, and a styptic metallic taste. Exposed to the air, it effloresces and becomes covered with a greenish-white powder of carbonate. It is insoluble in alcohol, but soluble in about two parts of boiling and four of temperate water. The ordinary blue vitriol, exposed to a temperature of 400° F., loses water of crystallisation, becomes a yellow-white powder ($Cu\ SO_4$), and is used for testing alcohol and other liquids for water, which it seizes, regaining its blue colour.

Actions and Uses.—Large doses produce fatal gastro-enteritis. Repeated full doses induce vomiting in carnivora; and in all animals in whom it is retained, intestinal irritation, with paralysis not unlike that of lead. Medicinal doses are antiseptic, astringent, and tonic. It causes prompt emesis in carnivora. Externally, it is used as a stimulant, astringent, and caustic. Like many other metallic salts, it arrests the action of enzymes and of organised ferments.

Toxic Effects.—Hertwig records that large doses (above twelve drachms for horses and cattle, one drachm for sheep or swine, and half a drachm for dogs) cause indigestion and impaired appetite; in carnivora, vomiting and diarrhœa; the evacuations are tinged green or blue, and mixed with blood; and fatal inflammation of the stomach and intestines usually follow. Drouard found that sixty grains retained in the stomach of a dog killed it in half an hour, but left little appearance of inflammation. Mitscherlich found that two drachms speedily killed dogs, leaving " blueness of the villous coat of the stomach, mingled with brownness, the apparent effect of chemical action." A drachm applied to a wound caused, in dogs, rapid prostration, and death in four hours. Injected into the jugular vein, it speedily reduces and arrests the action of the heart, fifteen grains proving fatal in twelve seconds (*Christison On Poisons*). In poisoning by copper salts,

the appropriate remedies are white of egg or milk, which form insoluble innocuous albuminates; iron filings, which attract and fix the copper; or potassium ferrocyanide, which produces a comparatively insoluble and harmless salt.

Medicinal Uses.—Copper sulphate is given to dogs and cats, as a promptly-acting **effectual emetic,** specially useful in narcotic and phosphorus poisoning. It acts both on the stomach and the vomiting centre (p. 78). It is prescribed for all animals in **atony and excessive mucous discharges,** especially from the alimentary canal. In chronic diarrhœa and dysentery, it is prescribed with opium. In nasal gleet it is sometimes conjoined with cantharides. In glanders, farcy, purpura, and other typhoid complaints, it improves appetite, diminishes abnormal secretion, and imparts vigour. In grease, it is used both internally and locally. Given in bolus, administered fasting, and repeated daily for a week, it is a useful general **vermifuge** for the horse; and the repeated doses are followed by a dose of physic. As a **nerve-tonic,** it is prescribed especially for weakly dogs affected by epilepsy and chorea.

Externally applied, it has little action on the unbroken skin, but on denuded cutaneous surfaces, and on mucous membranes, it combines with albumin, and is a **stimulant, antiseptic, and caustic.** It is used in ophthalmia, as a spray and gargle for ulcerated sore throat, as a dressing for sluggish wounds, discharging and parasitic skin diseases, exuberant granulations, warts, farcy-buds, fistulæ, and foot-rot in sheep, and as a styptic for arresting hæmorrhage from superficial vessels.

Doses, etc.—As a tonic and astringent, horses take ʒi. to ʒij.; cattle ʒi to ʒiv.; sheep, grs. xx. to grs. xxx.; pigs, grs v. to grs. x.; and dogs, gr. $\frac{1}{4}$ to grs. ij. These doses, repeated twice a day, are administered either in bolus or dissolved in some mucilaginous solution; and as tonics are best given along with food, or immediately after eating. Unless in very small doses, it cannot in horses or dogs be persisted with, like an iron salt, as it is apt to interfere with appetite, and even cause nausea. As a prompt emetic for the dog, grs. vi. to grs. x. are given dissolved in water; and about double that

amount for pigs of 100 lbs. weight. **Externally,** the powder or a watery solution is used. Shepherds make a useful ointment for foot-rot by mixing equal weights of powdered blue vitriol, gunpowder, and hog's lard. A more convenient and adhesive application is prepared by carefully mixing over a slow fire one part of powdered blue vitriol, with one of lard and two of tar.

The ammonio-cupric sulphate ($Cu\ SO_4.\ 4NH_3.\ H_2O$) is used in a hydrated state as a test for arsenic (p. 239), and is occasionally substituted for the sulphate as a tonic.

COPPER IODIDE. Cupri Iodidum. Cuprous Iodide. $Cu_2\ I_2$.

Although not recognised by the B. P., copprous iodide is noticed in *Morton's Veterinary Pharmacy* and in *Professor Tuson's Veterinary Pharmacopœia.* It is the by-product in one of the processes for iodine, and is also obtained by mixing solutions of cuprous sulphate and potassium iodide. It is a fawn-coloured salt, has a disagreeable, styptic, coppery taste, and evolves an odour of iodine. It was introduced into practice in the belief that it conjoined the actions of its two constituents; but large doses, in which its characteristic actions should be most obvious, produce the effects of other soluble copper salts. It has been recommended as a stimulating tonic in glanders, farcy, and chronic œdema of the legs, and as an astringent in ill-conditioned ulcers and inveterate grease (*Morton's Pharmacy*).

COPPER SUBACETATE. Verdigris. Blue Verdigris. Ærugo.

Chemists describe five acetates of copper. Of the sub- or di-acetate, two varieties are made—one in this country, distinguished by its green colour; the other abroad, especially in the south of France, of an azure-blue colour. It is usually prepared by placing plates of copper in layers, alternated either with woollen cloths saturated with acetic acid, or, according to the foreign method, with the moistened husks of the grape and the refuse of the wine process. Exposed for about a month to the conjoined action of air and acid, verdigris is formed as a

paste on the copper plates, and chiefly consists of the compound $(CH_3. CO_2)_2$ Cu. CuO. $6H_2O$.

It occurs either in amorphous masses or powder, is blue or green, according to the mode of preparation, and has the taste and odour of a copper salt. It remains unchanged in air; when heated, it gives off water, acetic acid, and acetone, leaving a residue of oxide and metal.

Actions and Uses.—Like other copper salts, verdigris is an irritant poison. It is emetic, antiseptic, astringent, and tonic, but is rarely used internally. It is employed externally as a caustic, stimulant, astringent, and antiseptic. Drouard exhibited twelve grains to a strong dog while fasting, and observed aversion to food, efforts to vomit, diarrhœa, listlessness, and death in twenty-two hours. Paralysis of the hind extremities was also observable in some cases, but in none was the stomach much inflamed. The normal acetate $(CH_3. CO_2)_2$ Cu H_2O) appears even more active; for, Orfila found that twelve to fifteen grains given to dogs, besides gastric irritation, produced convulsions, tetanus, sometimes insensibility, and death within an hour (*Christison On Poisons*). Hertwig observed that one ounce administered to a horse caused colic, with acceleration of the pulse; and that two ounces, given some hours after, aggravated these symptoms, causing first acceleration and then depression of the pulse, debility, and, after six hours, convulsions and death. Prescribed internally, the doses are the same as those of the sulphate. The external uses are also the same. It is applied in the form of powder, solution, and ointment, which is made with one part of verdigris and eight or ten of lard or of resinous ointment. A useful dressing for foot-rot in sheep is made with one part of acetate to three or four parts of lard, oil, or tar.

CREASOTE.

Creasotum. Kreasote. A product of the distillation of wood-tar. (B P.)

Tar obtained from hard woods yields twenty to twenty-five per cent. of creasote. The commercial process of extraction is tedious and complex, requiring repeated distillations and the re-

moval of the lighter paraffin oils. It consists of a series of phenoloid oils, of which the most important are phenol, cresol, phlorol, guaiacol, and creosol (*Bloxam*).

Creasote is a mobile, oily, neutral fluid, with the spec. grav. 1·071; colourless and transparent when first prepared, but, unless very pure, soon becoming brown. It has a strong, persistent, smoky odour, and a pungent, acrid taste, with a sweet after-taste. It requires for solution eighty parts of water, but readily dissolves in alcohol, ether, acetic acid, and volatile oils. Dropped on white filtering paper, and exposed to a heat of 212° F., it leaves no translucent stain. (B. P.)

Impure carbolic acid and other coal-tar oils, frequently mixed with or substituted for wood creasote, are **distinguished** from it by their greater solubility in water; by their solidifying in acicular crystals at low temperatures (p. 305); by their not affecting a ray of polarised light, which creasote turns to the right; by their producing a clear jelly when shaken with collodion, which does not affect wood creasote; while their watery solution gives a blue colour, with a neutral iron perchloride solution, which gradually browns the watery solution of wood creasote.

Actions and Uses.—Creasote belongs to the aromatic series of carbon compounds (p. 270). It nearly resembles carbolic acid. It is occasionally administered to arrest gastro-intestinal fermentation, and diminish fœtor of the discharges. It is used externally as an antiseptic, and for the destruction of skin parasites.

General Actions.—When undiluted, it coagulates the albumin and destroys the epithelium of mucous membranes, and even of the skin, producing the effects of a burn. Although in saturated solution it has little effect on enzymes, 1 part in 500 of water arrests the action of yeast; while 1 to 1000 of water kills bacteria (*Bucholtz*). **It is absorbed,** and communicates its odour to the various tissues. Large doses, when given internally, cause nausea; in carnivora, vomiting, colicky pains, and diarrhœa, with quickened, weakened pulse, slow and laboured respiration, increased secretion of urine, and occasionally muscular paralysis and sudden death. It is **excreted** by various channels, chiefly by the kidneys.

Although closely **resembling** carbolic acid, it differs from it in not producing convulsions; while it causes in fatal cases more coagulability of the blood.

TOXIC EFFECTS.—Three drachms given to horses caused slight and temporary feverishness, and imparted to the breath a creasote odour (*Hertwig*). Thirty drops given to dogs by Sir J. R. Cormack caused uneasiness, copious salivation, vertigo, muscular twitching, enfeebled and fluttering action of the heart, laboured breathing, diminished sensibility, dulness, and stupor. The symptoms came on within a few minutes, and continued for two or three hours. For a day or two, however, irritability of the stomach, occasional vomiting, and dulness, were still observable. Two dogs got two drachms each, and died within three hours, evincing, besides the symptoms above-mentioned, violent convulsions and complete coma. A rabbit was thrown into convulsions, and died within a minute, from the effects of thirty drops (*Treatise on Creasote, Harveian Prize Dissertation*, 1836). From the prominence of the convulsions in these cases, it is probable that the creasote was largely mixed with carbolic acid. The **antidotes** have already been enumerated (pp. 122 and 309).

MEDICINAL USES.—It is prescribed to arrest undue **fermentative changes** in some forms of indigestion, and is given to dogs in chronic vomiting (p. 81) With chalk and catechu mixture, or a little laudanum and an aromatic, it helps to check **diarrhœa and dysentery.** A few drops inhaled with steam benefit chronic **bronchitis** and **lung complaints,** when accompanied by excessive and fœtid discharges. At The Royal (Dick's) Veterinary College, creasote was some years ago used in contagious pleuro-pneumonia among cattle, in doses varying from twenty to eighty drops, dissolved in volatile oil or acetic acid, with some advantage in relieving the distressed breathing and irritable bowels. It has been tried in glanders in horses, but without any very striking results. **Farcy and nasal gleet,** with enlarged glands and fœtid discharge, are sometimes, however, benefited by giving daily a drachm of creasote, with thirty minims sulphuric acid, made into bolus with linseed meal. In that form of diabetes insipidus common in horses, it usually does harm rather than good.

For external purposes, carbolic acid has superseded creasote as an **antiseptic** for wounds, as well as a **stimulant** and **escharotic** in caries, scrofulous tumours, fistulæ, canker, thrush, and foot-rot. Diluted with glycerin and water, or with vinegar, it is still occasionally used to relieve itching and remove scurf in chronic eczema, prurigo, and psoriasis. It **destroys parasites infesting the skin.** For mange and scab, Gerlach advises an ounce of creasote, dissolved in fifteen ounces of spirit and forty of water. For intractable follicular mange, after washing the dog with soap and water,—or, better still, shaving him,—Mr Hunting advises inunction of a mixture of one part of creasote and fourteen of olive oil, to which two parts of caustic potash solution, subsequently added, increase the penetrating power of the parasiticide. Human patients suffering from toothache depending on caries, are often relieved by a drop of creasote cautiously placed in the hollow of the tooth, where it unites with albuminoid matters, protecting the irritable nervous pulp from air and irritants.

Doses, etc.—For horses, ♏ x. to ♏ xxx.; for cattle, fʒss to fʒj.; sheep, ♏ v. to ♏ xv.; pigs, ♏ ij. to ♏ x.; dogs, ♏ i. to ♏ iij. It is given in bolus with syrup, or in solution with mucilage, acetic acid, volatile oils, or alcohol. As a stimulant or escharotic, it is applied with a camel's hair brush; is used in solution in spirit or acetic acid, or as an ointment, made with one part to eight of lard or simple ointment. For skin diseases, equal parts of creasote and sulphur may be made into an ointment with lard, or a liniment with oil. A few drops are sometimes added to turpentine, hartshorn, or other embrocations.

CROTON SEEDS AND OIL.

Croton Seeds. Semina Crotonis. The seeds of Croton Tiglium.
Croton Oil. Oleum Crotonis. Oil expressed in Britain from the seeds of Croton Tiglium. (B. P.). *Nat. Ord.*—Euphorbiaceæ.

The Croton Tiglium is a tree fifteen or twenty feet high, growing on the Indian continent, in Ceylon, and in many

islands of the Indian Archipelago. Its fruit or nut is somewhat larger than a hazel, of an oval triangular form, and contains three seeds about the size of French beans, resembling the castor-oil seeds in size and shape, and, when shelled, weighing on an average three grains each. They are brown, odourless, with a taste at first mild and mucilaginous, but soon becoming hot and acrid. When heated they yield irritating fumes. The thin brittle external shell constitutes fully one-third of the weight of the seed. Mr Morton found by experiment that the plumæ and testæ are less active than the cotyledons (*Veterinary Record*, 1846). The seed kernel contains fifty to sixty per cent. of fixed oil, which is separated by expression and purified by straining. The residuum from which the oil has been expressed is sometimes used under the name of croton cake; but the amount of oil retained is very variable, and its effects are irregular and uncertain.

The oil is viscid, of a brownish-yellow colour, with a peculiar nauseous odour and a persistent acrid taste. It is entirely soluble in alcohol, ether, the fixed and volatile oils. Besides fixed fatty acids, it contains **crotonic acid** ($C_4 H_6 O_2$) and **angelic acid** ($C_5 H_8 O_2$), but neither of these are believed to be purgative. **Crotonol,** a body resembling oil of turpentine, has been found by Schlippe, but not by other chemists; and although causing skin irritation, is devoid of cathartic effect. The active drastic principle, obtainable also from the wood and leaves, is believed to be **a resinoid body,** developed within the alimentary canal by saponification of the oil, set up by the intestinal alkaline secretions.

Actions and Uses.—Croton is an irritant poison; is used as a drastic hydragogue cathartic, and externally as a pustulant counter-irritant.

Toxic Effects.—Forty seeds destroyed a **horse** in seven hours, with acute gastro-enteritis; half that quantity usually produced fatal inflammation (*Hertwig*). Mr Morton administered to two different horses twenty bruised seeds, and observed super-purgation, accelerated pulse and respiration, injected mucous membranes, collapse, and death in eighteen and twenty-four hours. Medicinal doses sometimes cause, alike in horses and dogs, unexpected and serious irritation. In India the

seeds are occasionally given to poison horses. Orfila gave a **dog** three drachms, which killed him in three hours; one drachm was also fatal; while Hertwig found that ten or twelve grains induced violent purgation, gastro-enteritis, and death in four to seven hours if vomiting was prevented by tying the œsophagus. About the same quantity of the bruised seed or oil, which proves fatal when given to any animal internally, has the like effect when placed in the areolar tissues, or applied to a wound. Hertwig states that eight drops injected into the jugular vein killed a horse, while two drops killed a dog. Moiroud records that twelve drops injected into the veins of a horse produced in a few minutes alvine evacuations; and that thirty drops caused speedy death. Fifty drops in alcoholic solution, applied to the belly of a small horse, caused next day alvine evacuations of normal consistence, but three or four times more abundant than natural, and continuing so for two days. Thirty drops had similar effects on sheep, fifteen to twenty on dogs (*Hertwig*). The irritant action of croton is often exerted on men shelling the seeds, inducing swelling and inflammation of the face and other parts exposed to the croton dust.

Post-mortem examination discovers inflammation both of the small and large intestines; in poisoning in horses the cæcum and colon are especially affected, usually exhibiting much extravasation of blood, and occasionally patches of erosion; sometimes the lungs are congested, and occasionally they are inflamed. (*Hertwig*, and *Professor John Gamgee's Veterinarian's Vade Mecum.*)

As a drastic and hydrogogue cathartic croton **resembles** gamboge and elaterium—a sediment from the juice of the fruit of the squirting cucumber. It operates more speedily than aloes, and produces more frequent, full, and fluid dejections. **For horses,** croton is, however, too violent and irritating for safe or general use. **For cattle** it is sometimes valuable, operating with certainty when most other purgatives are ineffectual, and if carefully used, is rarely attended with evil consequences. **For sheep** it is too irritating and depressing to be generally available. **For dogs and pigs** it is a prompt and effectual drastic purge, requiring, however, as in other

patients, to be used with much caution. Professors Rutherford and Vignal have shown that although causing great dilatation of the vessels of the intestinal mucous membrane, it has no special cholagogue action.

MEDICINAL USES.—Croton is used as an **active hydragogue cathartic for cattle** suffering from fardel-bound and other forms of constipation, from torpidity of the bowels dependent on disordered states of the nervous system, and from phrenitis and parturient apoplexy. It is serviceable where bulky medicines are inadmissible, where animals are unmanageable, or have difficulty in swallowing, where it is requisite promptly to produce copious fluid evacuations and extensive counter-irritation. It is contra-indicated in young and delicate subjects, in all debilitating complaints, and wherever any portion of the alimentary canal is in an irritable or vascular state. The evil effects of **overdoses are abated** by demulcents and opium given by the mouth and rectum, by hot cloths to the abdomen, and, if need be, by stimulants to counteract depression.

Croton oil is sometimes used **externally as a counter-irritant.** Like tartar emetic if freely applied, it speedily produces an eruption of pimples, soon assuming the character of pustules, and attended by considerable irritation, inflammation, and swelling of surrounding parts. Its effects are increased when it is used with an alkali. Applied freely, especially if the skin be thin or abraded, absorption occurs with production of catharsis. Although too irritating either for horses or dogs, it is sometimes applied to cattle, which are less apt either to be purged or blemished. It may be used in laryngitis, chronic glandular enlargements, and tedious articular rheumatism.

DOSES, ETC.—Ten or twelve seeds, which, allowing three grains for each, weigh from thirty to thirty-six grains, is the dose if it be given to the horse; fifteen to twenty seeds for cattle; three or four for sheep; two or three for pigs; and one or two for dogs. The dose of croton oil for the horse is ♏xv. to ♏xxv.; for cattle, f℥ss. to f℥ij.; for sheep and swine, ♏v. to ♏x.; and for the dog, ♏ii. to ♏iij. The dose of the so-called croton cake is stated to be double that of the fresh croton bean; but, as already indicated, it is an uncertain pre-

paration. The bruised seeds and the oil are administered made into bolus with linseed meal, or dissolved in linseed oil. They are less irritating and more certain and regular when conjoined with other purgatives. In obstinate constipation or torpidity of the bowels among cattle, half doses are given with one or two scruples of calomel, a pound of salts, or a pint of linseed oil; and few purgative mixtures are more effectual. Some practitioners drop the oil in an undiluted state on the tongue; but this is not advisable, as it is apt to adhere to the tongue and fauces, causing irritation and inflammation. For **external** purposes, the oil is dissolved in six or eight parts of soap liniment, or in a mixture of linseed oil and oil of turpentine. Added even in small quantity to blistering ointments, croton oil promotes their activity, but in horses also increases their tendency to blemish.

CURARE.

CURARA. Woorara. Woorali. Urari. A South American arrow poison. An extract from one or more species of Strychnos, mixed with some mucilaginous juice, and owing its activity to an alkaloid—Curarine (C_{10} H_{15} N).

It is a black-brown substance, with a very bitter taste, and imperfectly soluble in water. It appears to vary somewhat in composition, and two varieties have been described. **It paralyses the peripheral endings of motor nerves;** large doses paralyse the vagus and ends of sensory nerves, the spinal cord, and eventually the muscles of respiration and the heart. The voluntary muscles are little affected. Although the blood becomes charged with carbonic acid, the motor nerves are so paralysed that convulsions do not occur; and artificial respiration, persisted with, prevents death even when lethal doses have been given, for the poison is quickly eliminated by the kidneys. This is strikingly illustrated by the fact that the urine of a frog, poisoned by curare, will paralyse a second frog, injected subcutaneously, and the urine of the second will even paralyse a third (*Brunton*).

It is allied to hemlock and coniïne, and to methyl-strych-

nine, methyl-brucine, and methyl-thebaine (p. 52). Some of its effects are antagonised by strychnine. It has been given in chorea, epilepsy, tetanus, and hydrophobia; but in none of these cases has its efficacy been established.

The doses for horses and cattle are from gr. $\frac{1}{2}$ to gr. j; for dogs, gr. $\frac{1}{20}$ to gr. $\frac{1}{5}$. It acts more powerfully when injected intravenously or subcutaneously than when swallowed.

DIGITALIS.

FOXGLOVE. The leaves of Digitalis purpurea. Collected from wild British plants of the second year's growth when about two-thirds of the flowers are expanded, and carefully dried (B. P.). *Nat. Ord.*—Scrophulariaceæ.

Digitalis grows wild in this country and in many parts of the Continent, on gravelly, sandy soils, in young plantations, on hedge sides, and hill pastures. Other species have probably the same properties as the D. purpurea, alone recognised by the B. P. It is herbaceous, biennial or perennial, with numerous drooping, purple-spotted, occasionally white flowers, an erect stem one to five feet high, and large alternate ovate-lanceolate, crenate, rugose leaves, downy, especially on their paler lower surfaces, and tapering into winged foot-stalks. The leaves, the officinal part of the plant, are gathered late in June or in July, before the small round grey-brown seeds begin to ripen, and when about two-thirds of the flowers are expanded. The velaes of the second year's growth are generally more active than those of the first. They are dried in baskets, in darkness, over stoves, and are then of a dull-green colour, with little smell, and a nauseous, bitter taste. They should be used when fresh; twelve months' keeping greatly diminishes their activity. Both the roots and seeds are bitter, and probably active.

Digitalis has recently been examined by Schmiedeberg, who has isolated **five non-nitrogenous principles**:

(1). **Digitalin,** a bitter glucoside, insoluble in water but readily soluble in alcohol. The commercial digitalin appears to be a mixture of digitalin with digitoxin. It is a cardiac poison, and the two following constituents resemble it.

(2). **Digitoxin** is a crystalline body, insoluble in water but sparingly soluble in cold alcohol. It is the only one of the five which is not a glucoside.

(3). **Digitaleïn** is bitter and amorphous, and readily soluble both in water and alcohol.

(4). **Digitonin** is freely soluble in water; resembles saponin, the active principle of quillaia, the Chili soap bark; is a powerful irritant, local anæsthetic, and muscular paralysant; and hence is in some degree antagonistic to digitalin, digitoxin, and digitaleïn.

(5). **Digitin** appears to be inert.

Products of decomposition of these principles seem to be present especially in preparations of the drug exposed to high temperatures. The proportion of the five constituents appears to vary in different specimens of digitalis grown in different climates and circumstances, and also in different preparations of the drug, resulting in part from the degrees of solubility of these several constituents in water and alcohol. The tincture contains chiefly the first three principles, and appears to be most suitable as a heart tonic, while the infusion containing more digitoxin is more active as a diuretic.

ACTIONS AND USES.—Digitalis and digitalin act upon the heart and arterioles. Medicinal doses increase the force and co-ordinating power of the heart. Large doses, with gastric irritation and derangement, disorder, exhaust, and arrest heart action, and dilate arterioles. The drug and its active principles are excreted by the kidneys; in moderate doses cause diuresis, but in poisonous doses arrest urinary secretion.

GENERAL ACTIONS.—Digitalis and digitalin, in large doses cause nausea; in carnivora, vomiting; in all animals, muscular weakness, laboured respiration, diuresis, irregular heart action, rise of blood-pressure, followed by failure of pressure and death. They **paralyse voluntary muscles.** They do not affect the brain or spinal cord nor sensory or motor nerves. They temporarily quicken and more notably and permanently slow respiration. Their **action on the circulation,** which determines most of their curative uses, is divisible into four stages.

(1). Rise of blood-pressure, usually accompanied by slowing

of the pulse, and dependent on increased action of the heart and contraction of the arterioles.

2. Continued rise of blood-pressure. The pulse, previously slow from stimulation of the vagus roots and increased sensibility of the nerve-endings in the heart, becomes quickened, owing to paralysis of the vagus endings.

3. Continued high pressure, with irregularity of the heart's action and pulse rate, resulting from direct cardiac paralysis.

4. Rapid fall of blood-pressure, sudden stoppage of the heart, and death. The heart usually stops before the respiration, and is arrested sometimes in systole, sometimes in diastole.

Digitalis developes **diuresis** by increasing blood-pressure and contracting arterioles in the intestines and throughout the body, as well as by its more local effect on the kidney (p. 106). The absolute amount of urinary solids is usually increased. Poisonous doses, however, contract the renal vessels, and diminish or even arrest urinary secretion. Unlike many other diuretics, it does not irritate the kidneys; but large doses arresting their action, delay excretion of the drug, intensifying its effects, and thus developing its so-called **cumulative action** (*Brunton*).

Various drugs **resemble** digitalis.

The seeds and alkaloid of the Strophanthus hispidus, which are cardiac tonics of even greater power than digitalis, produce more marked effect on the heart, but less on the arterioles, and also act as diuretics.

Scillaïn—the active principle of squills.

Adonidin—from the Adonis vernalis.

Convallamarin—from Convallaria Majalis—lily of the valley.

Antiarin—from the Upas Antiar or Antiares toxcaria—a tree of the bread-fruit tribe, and producing the Javanese arrow-poison.

Helleboreïn—from Helleboris niger.

Nereïn—from the Nerium oleander.

Erythrophlœin—from Erythrophlœum Guinense—yielding the African poison casca or doom.

Toxic Actions.—A horse was poisoned in twelve hours by two ounces of dried powdered leaves (*Moiroud*). One ounce, and in some cases six drachms, given to horses in bolus,

caused, in three to ten hours, loss of appetite, frequent urination, fluid fæces, sometimes tinged with blood, a pulse at first full and increased, but afterwards small, slow, and irregular, contraction of the pupil, difficulty of breathing, languor, and, after twelve or sixteen hours, death (*Hertwig*). Messrs Bouley and Reynal, administering large doses to horses, observed quickened circulation, abrupt and energised heart-beats characterised by a vibratory thrill, and subsequently by a bellows murmur, with intermittent beat, the pulse, as death approached, numbering 120 to 140. Smaller doses, after slight acceleration, were found to lower pulsations to 20 or 25, and render the several cardiac sounds particularly distinct.

The following cases, in which I gave full medicinal doses of digitalis to healthy horses, illustrate its effects on the heart, its nauseating action, and its irritation of the digestive organs.

In February 1856 powdered digitalis was given to three horses in good health, and receiving daily 12 lbs. hay, 5 lbs. oats, and 5½ lbs. bran. On the 20th they each received a drachm of the powder at 12 noon, and another drachm at 6 P.M.; on the 21st and 22d one drachm at 6 A.M., at 12 noon, and 6 P.M.; and on the 23d a drachm at 6 A.M.—in all, nine doses of a drachm each in three days.

No. 1. Brown Mare, 3 years old:

Feb. 20.	12 noon,	pulse 38,	respirations 8.
21.	. .	34,	. . 6.
22.	. .	28,	. . 7.
23.	. .	28,	. . 7.

On the evening of the 22d she became dull, and refused her feed. 23d, 10 A.M.—Still dull, without appetite, pupil contracted, passing wind, with small quantities of fluid fæces. 4.30 P.M.—Pulse 32, more distinct than at noon, pupil considerably contracted, rather less dulness. On the 25th, two days after the medicine was withdrawn, the mare was eating, and perfectly well again.

No. 2. Bay Gelding, 3 years old:

Feb. 20.	12 noon,	pulse 36,	respirations 7.
21.	. .	36,	. . 8.
22.	. .	30,	. . 6.
23.	. .	32,	. . 6.

23d, 12 noon.—Pulse, both yesterday and to-day, slightly irregular; no appetite, very dull and stupid, with the pupil somewhat contracted. 4.30 P.M.—Pulse 34, tolerably firm, but unequal; eating a little, and scarcely so dull. No more digitalis being given, the animal recovered its appetite, and by the 26th was well again.

No. 3. Brown Mare, 3 years old:

Feb. 20.	12 noon,	pulse 38,	respirations 8.
21.	. .	33,	. . 7.
22.	. .	34,	. 7½.
23.	. .	120,	. 20.
24.	. .	120,	. . 25.

Towards the evening of the 22d the mare became dull, and would not feed. 23d, 10 A.M.—Very much nauseated; nose, mouth, and ears cold; abdomen tympanitic, with colicky pains, and occasional pawing; pupil somewhat contracted; pulse firm at axilla and heart, but not very perceptible at the jaw. Had four drachms of carbonate of ammonia and clysters occasionally, the stimulant being repeated at two o'clock and four. At 4.30 P.M. she was down, much pained, attempting to roll; pulse 82, but unequal. 24th, 12 noon.—Pulse imperceptible at jaw, about 120; respirations 25, and very much laboured; lips retracted, and saliva dripping from the mouth; enormous abdominal tympanitis and much pain; rapid sinking; died on 25th at 11 A.M.

Post-mortem examination made next morning at 9.30. Voluntary muscles unusually pale; spots of ecchymosis found in the areolar textures, between the muscular fibres, and in places underneath the skin. Lungs and pleuræ healthy; anterior extremity of lungs contained more blood than posterior; venæ cavæ contained the usual amount of dark non-coagulated blood; bronchial tubes inflamed for about six inches along their anterior ends; windpipe inflamed half-way up the neck, and containing flakes of greenish pus, mixed with mucus; no froth here, or in bronchi. Heart pale, friable, containing a small clot of blood in its left ventricle, and about five ounces of non-coagulated blood in the right ventricle. A rent of eight inches long was found in the inferior curvature of the stomach, through which food had passed into the omentum; the mucous membrane of the stomach was quite healthy; the organ itself very large, but collapsed, in consequence of the rupture; the intestines were pale and flaccid, and contained enormous quantities of food and gas, but their mucous membrane was quite healthy. The kidneys and generative organs, with the brain and spinal cord, were perfectly healthy.

Dogs receiving one or two drachms were nauseated, and when vomiting was prevented, moaned and exhibited abdominal pain, green-coloured fluid dejections were passed, the pulse was feeble and indistinct, breathing irregular and distressed, spasmodic efforts were made to empty the bladder, muscular debility preceded death (*Tabourin*). **Pigs** poisoned by decoction of the leaves are reported to be languid, attempt to vomit, strain and pass small quantities of fæces; whilst after death the mucous coat of the stomach and small intestines is inflamed, the kidneys slightly congested, the bladder empty. (*Veterinarian*, March 1872).

MEDICINAL USES.—Dr. Ringer believes that digitalis exerts its curative effects in one or more of the following ways:—1st. By strengthening the action of the heart; 2d, by reducing the strength of the beats of a heart acting too powerfully; 3d, by lessening the frequency of the heart beats; 4th, by correcting irregular action of the heart (*Handbook of Therapeutics*).

When the heart is enfeebled or acting irregularly, as in horses suffering from influenza or other exhausting disease, in

cattle convalescing from pleuro-pneumonia or rheumatic fever, in dogs debilitated by distemper or over-work, digitalis **imparts co-ordination and expulsive power** to the ventricles, and tone to relaxed capillaries, and thus renders the weakened, irregular circulation stronger, steadier, and slower. It moreover usually relieves difficulty of breathing or dropsical effusion which has resulted from imperfect action of the heart. In such cases digitalis is usefully conjoined, according to circumstances, with potassium chlorate or nitrate; or with alcohol, ether, or ferric chloride. **Palpitation** in horses, resulting from unwonted over-exertion, or from fast work performed shortly after a full meal, occasionally persists for several days; the violent noisy impulse of the heart, accompanied by lifting of the flanks, comes in paroxysms: repeated doses usually control such inordinate, tumultuous functional disturbance. In the more violent of these cases Professor Robertson conjoined with the digitalis small doses of aconite, and in other cases prescribed it with belladonna. In **dilatation** of the heart, with insufficiency of the mitral valves, carefully-regulated doses of digitalis abate dyspnœa, the cold extremities, venous pulse, and œdema. In **dilatation or hypertrophy** of the left ventricle—common in hard-worked, aged horses—even when accompanied by a slight amount of valvular disease, the full, strong, intermittent pulse is usually moderated, its unduly forcible impulse quieted, and the breathing relieved by digitalis. In such cases of hypertrophy, when the pulse is full and strong, one or two small doses of aconite may first be tried.

In **pericarditis,** after the more acute symptoms have been subdued with salines, digitalis frequently lessens the embarrassed breathing and the friction sound. In endocarditis, occurring occasionally in cattle, it renders the heart-beat more regular, and gives more fulness to the small thready pulse. It has no effect in reducing temperature, and is not now used in febrile attacks. Although of no value in pneumonia, it is still sometimes employed by veterinarians as a constituent of **cough mixtures.** Quieting and regulating the action of the heart, and contracting arterioles, it is recommended in **hæmorrhages,** especially from the lungs and stomach. **Professor Dick's recipe for thick and broken wind** consists of thirty grains

each of calomel, digitalis, opium, and camphor, and its efficacy in great part depends upon the calomel regulating the bowels, while the other three ingredients abate the cardiac irritability so notable in such cases. Where the medicine was to be persisted with daily for a week, or longer, the Professor usually advised omission of the calomel.

Digitalis relieves many cases of **dropsy,** by regulating the heart-action and contracting dilated capillaries, as well as by its diuretic effect. In pleuritic effusions, Professor Robertson gave horses digitalis, grs. xx. to grs. xxx.; potassium nitrate, ʒij.; powdered cantharides, grs. iv. to grs. x., made into bolus, and repeated twice daily for a week. Diuresis is determined by prescribing digitalis with salines—a combination often useful in anasarca, ascites, and œdema, especially when connected with obstructed cardiac circulation. Applied locally, it contracts the small arteries (*Dr Fothergill*).

The chief **indications for the use** of digitalis are an enfeebled, irritable, jerking, or irregular action of the heart; deficient arterial pressure; venous engorgement, and scanty secretion of urine. It is more suitable for chronic than acute cases, for combating functional rather than organic mischief. As with other tonics, it is best tolerated in those weak and irritable states of the heart in which it is most serviceable. It is of little use in difficulty of breathing or dropsical conditions dependent on lung disease. It does harm in aortic disease or in hypertrophy, where the pulse continues strong, firm, and regular; or in enfeebled circulation dependent on advanced fatty degeneration. Nausea or irritability of the digestive organs, coldness of the extremities, unwonted force of the pulse-beats, indicate that the medicine should be stopped, or given in reduced amount. The effects of **over-doses are combated** by alcohol or other stimulants, and by keeping the patient perfectly quiet.

Doses, etc.—Of the powdered leaves, horses take grs. x. to grs. xxx.; cattle, ʒss. to ʒj.; sheep, grs. viij. to grs. xv.; pigs, grs. ij. to grs. x.; dogs, grs. i. to grs. iv. The **infusion** is made by digesting for fifteen minutes 1 part dried leaves with 156 fluid parts of distilled water. The **tincture** is made by maceration and subsequent percolation of 2½ ounces dried leaves

with 1 pint proof spirit (B. P.) It contains $54\frac{1}{2}$ grains to the fluid ounce, is about twenty times the strength of the infusion, and is the most suitable preparation for cardiac cases. Horses and cattle take f℥ii. to f℥iv.; sheep, f℥j.; dogs, ♏ij. to ♏x. The **fluid extract** used in the United States is nearly ten times the strength of the B. P. tincture. Commercial **digitalin** is 600 or 700 times the strength of the tincture, the dose for human patients ranging from $\frac{1}{60}$ to $\frac{1}{30}$ of a grain. The leaves and preparations of digitalis are not always of uniform strength, chiefly depending upon varying activity of the leaves grown under different conditions, prolonged keeping, variations in the method of preparation, and different proportions of the active constituents. It is hence desirable, when using unfamiliar specimens of the drug, and still more of its more active preparations, to begin with moderate doses, and narrowly watch their effects.

ERGOT OF RYE.

ERGOTA. Spurred or Horned Rye. Secale cornutum. Ergot. The sclerotium of Claviceps purpurea, produced between the pales and replacing the grain of Secale cereale, the Common Rye.—(B. P.) *Nat. Ord.*—Graminaceæ.

Ergot attacks not only rye, but the other Graminaceæ, the Cyperaceæ, and palms. The earliest symptoms occur about the time of blooming, when the ears of the rye exhibit drops of yellow, sweet, fungous slime, called honeydew, which attracts ants and beetles, and which after a few days dries up. The soft ovaries of the grains attacked are meanwhile covered and filled by white, spongy, felted-together cells—the mycelium of the Claviceps purpurea. The grain is disintegrated; at its base the mycelium cells separate, swell, solidify, and form a compact dark violet body, which, as it grows in a curved, horn-like shape, protrudes from the pales, and constitutes the ergot. The further history of this biennial fungus, investigated by Tulasne, shews that it reaches its fully developed sclerotium or ergot state in July; it should be gathered in August or September, before any putrefaction appears; it usually remains in a quiescent state during winter; on moist mould in March

or April, it produces fruit heads of the perfect fungus, the Claviceps purpurea, which, after a few weeks, is again ready to distribute its earlier spores. Close damp weather and undrained soils favour development and distribution of these ergot spores as of other fungi. The injury done to the rye crop by ergot varies much; sometimes only a few grains in each head are diseased, sometimes scarcely one is altogether sound; five to ten on an average are affected. It abounds both in grain and grasses in various parts of the United States of America, where it is stated that as much as 1 lb. has been got from 100 lbs. of hay. It should be collected before the plants are cut.

PROPERTIES.—Ergot of rye is cylindrical, curved, resembling a horn or a cock's spur; it varies in length from one-third of an inch to an inch and a half, and in breadth from one to four lines; is marked by a longitudinal furrow on its concave side; is obtuse at its ends; has at its apex a pale grey fragile excrescence, the shrivelled remains of the style, and is covered by the grey, powdery conidia or spores. It is dark violet-coloured externally, and greyish-yellow within. Its odour is dull and musty; its taste, at first sweet, becomes bitter and slightly acrid. When dry it is inflammable, hard, and brittle; when moist, or long exposed, it becomes soft, darker in colour, and covered with acari. Its structure is made up of felted thread-like cells, amidst which lie drops of oil. Infused in boiling water, it forms a claret-coloured solution, retaining the odour, taste, and actions of ergot.

The chemistry of ergot is still unsettled. It contains about thirty per cent. of a non-drying fixed oil, which has no special action; a peculiar sugar termed mycose; lactic, acetic, and formic acids; colouring matters; and, according to Kobert of Strasburg, three active principles—an alkaloid, **cornutine,** and **sphacelinic and ergotinic acids** (*Practitioner*, xxxiii. 429). **Ergotin** is a red-brown, watery extract, containing, as prepared by different makers, variable proportions of the active principles.

ACTIONS AND USES.—Ergot, cornutine, and sphacelinic acid stimulate and contract involuntary muscular fibre. Large and continued doses contract the arterioles, causing (1) impaired nutrition, especially of the extremities, producing

gangrene; and (2) imperfect nutrition of the cord and nervous centres, leading to anæsthesia and convulsions. Medicinal doses are given to excite contraction of the uterus and of the blood-vessels, and thus arrest hæmorrhage.

General Actions.—The physiciological effects of the three active principles of ergot are thus described by Dr Lauder Brunton :—

Cornutine causes spastic rigidity in frogs, lasting many days, even when given in very minute doses ($\frac{1}{32}$ of a milligrame). In warm-blooded animals, $\frac{1}{2}$ a milligramme causes salivation, vomiting, diarrhœa, and active movements of the uterus, which are clonic and not tonic. The vessels are contracted and the blood-pressure raised.

Sphacelinic acid causes at first great spasmodic contraction of the blood-vessels, with rise of blood-pressure, and subsequently symptoms of gangrene. The heart is unaffected. Tetanus of the uterus is produced. Cornutine and sphacelinic acid are evidently the principles which cause uterine contraction (*Kobert*).

Ergotinic acid causes ascending paralysis of the spinal cord and brain both in frogs and mammals, with loss of voluntary motion, paralysis of the vaso-motor centre, and fall of blood-pressure, while respiration and reflex irritability continue. It does not appear to have the power of increasing uterine contractions, and so cannot be regarded as the most important constituent of ergot (*Pharmacology*).

Ergotin, or Bonjean's ergotin, when injected into dogs or rabbits causes inco-ordination, anæsthesia, and paralysis, and death is due to **paralysis of respiration.** The muscles are unaffected; the motor-nerves are not paralysed, but, on the contrary, have their power somewhat increased; the sensory nerves are paralysed, but it is uncertain whether this action is central or peripheral. The spinal cord is paralysed (*Brunton*). The action of the heart is weakened; the pulse-rate slowed. Blood-pressure is first lowered, and then raised. Respiration in dogs is first quickened, but in most animals it is slowed from the beginning. It **contracts all unstriped muscular fibre;** it hence diminishes the calibre of blood vessels, as may be readily seen, in the web of the frog's foot; increases in-

testinal peristalsis; empties the urinary bladder; and expels the contents of the pregnant uterus. This uterine contraction is continuous and tetanic. Although due in great part to contraction of unstriped muscular fibre, it may also in part be determined by stimulation of the uterine centre in the spinal cord (p. 113).

Ergot, given experimentally in large or continued doses, or the protracted use of ergotted grain, causes a series of conditions known as **ergotism,** characterised by gastro-intestinal derangement, nausea, vomiting in animals capable of emesis, and diarrhœa, terminating either in gangrene or anæsthesia and convulsions.

Ergot **resembles** Ustilago or corn-smut—a fungus occurring on Indian corn (Zea Mays), recognised by the U. S. A. Phar., and probably containing the same active principles as ergot. Savin and thuja also cause uterine contractions. Digitalis has considerable power of contracting the involuntary fibres of arterioles. The physiological **antagonists** of ergot are ethers and amyl-nitrite.

TOXIC EFFECTS on horses, cattle, sheep, and rabbits are not so marked as on men and dogs. Thirty **cows** amongst them took daily with impunity 37 lbs. for three months; two milk cows had between them 9 lbs. daily, with no further evil effect than that the butter was badly tasted. Twenty **sheep** amongst them ate daily for four weeks 9 lbs without injury (*Phœbus and Pereira*). **Dogs** receiving six to twelve drachms suffered from vomiting, tenesmus, prostration of muscular power, enfeebled pulse, convulsive twitchings, spasms, and coma (*Tabourin*). Three ounces proved fatal to a terrier bitch in twenty hours.

Chronic poisoning occurs especially in patients placed in unfavourable sanitary surroundings. Dr Samuel Wright (*Edinburgh Medical and Surgical Journal*, vols. lii., liii., and liv.) found that ergot, given for several weeks to dogs and rabbits, caused nausea, impaired appetite, a weak irregular pulse, soon becoming intermittent, diarrhœa, excessive fœtor of the secretions and excretions, paralysis, particularly of the hind extremities, enlargement of the liver, contraction of the spleen, formation of tubercles both in the lungs and mesentery,

impairment of the special senses, wasting, and general debility. Gangrene of the extremities is not, however, produced so readily as in man. Dogs, cats, and rabbits shewed great aversion to it, even when it was mixed with sound grain, or considerably diluted with water; and, although pressed by hunger, would scarcely eat it of their own accord. Ergot of maize, according to Roulin (*Gamgee's Veterinarian's Vade Mecum*), is common in Columbia, and its continued use is stated to cause shedding of the hair, and even of the teeth, both of man and beast; mules freely fed on it lose their hoofs, and fowls lay eggs without shells.

Abortion from eating ergotted grasses occurs amongst cows, ewes, and deer in many grass districts of England and Ireland, especially in wet seasons, The hay from pastures subject to ergot is seldom, however, so injurious as the grass, for it is generally cut before the fungus is matured. Cows abort from this cause more frequently than ewes or deer; for they are more prone to eat the coarser, longer ergotted grasses, and moreover are often pregnant in the later months of summer when ergot occurs. Experimentally, abortion has been produced in guineapigs, sows, bitches, cats, cows, and ewes, and even in rabbits (*Stillé Therapeutics*). Youatt declared that he had never known ergot fail in its action on the pregnant uterus either of monogastrics or ruminants. The negative results obtained by some experimenters are doubtless explained by their having used the drug or its preparations, which have been spoilt, frequently by long keeping.

MEDICINAL USES.—As a **parturient,** ergot is seldom needed in the lower animals. The offspring, coming naturally at the full period, if assistance is requisite, are generally got hold of with the hand or forceps, and brought away with gentle traction. When used, it is in cases where there is uterine inertia, where the throes are languid and occurring at long intervals, where the animal has been in labour for some considerable time, where no obstruction is present, and where the os uteri is considerably dilated. It is unsuitable where there is malformation either of the mother or fœtus, where the position of the fœtus prevents its ready expulsion, and sometimes also in first pregnancies, where the uterus, roused to the continuous tetanic contractions,

is more liable to be injured or torn. After parturition, if the **uterus** remains **flaccid,** and especially if **hæmorrhage** occurs as occasionally happens both in cows and ewes, ergot effectually contracts the organ, and thus arrests the bleeding. In such cases it may be given by the mouth, or where prompt effects are sought, ergotin is injected hypodermically. It is sometimes prescribed to remove uterine cysts and hasten expulsion of the placenta, which in the lower animals may usually, however, be readily removed by the hand. Given either by the mouth or hypodermically, it is useful in all animals in hæmoptysis, and sometimes in hæmatemesis and other hæmorrhages. It is of no avail in purpura. Professor Robertson recommended it in cerebro-spinal meningitis in horses; and several practitioners have tried it, but without much success, in parturient apoplexy in cows.

Doses, etc.—Ergot, as an ecbolic for the mare or cow, ℥ss. to ℥i.; for sheep, swine, and bitches, about ʒi.; repeated at intervals of half an hour or an hour; the decoction swallowed, dregs and all, is the most economical and convenient preparation for veterinary practice. **Ergotin** is prescribed for horses or cattle in doses of grs. xv. to grs. xxv.; for dogs in grs. i. to grs. iv. When used hypodermically, smaller doses should first be tried.

ETHER.

Æther. Sulphuric Ether. A volatile liquid, prepared from alcohol, and containing not less than 92 per cent. by volume of pure ether. $(C_2 H_5)_2 O$ (B. P).

Ether is **prepared** by heating in a glass flask, connected with a Liebig's condenser, one part of sulphuric acid and five of rectified spirit, which is added gradually. The crude ether which distils over is purified by agitation with calcium chloride and quicklime, and re-distilling.

Ethyl-alcohol, when thus heated with sulphuric acid, yields sulphethylic acid—

$$C_2 H_5 OH + H_2SO_4 = HC_2 H_5 SO_4 + H O H.$$

While heat is maintained, and more alcohol furnished, the

sulphethylic acid is decomposed into ether and sulphuric acid, which is ready again to decompose fresh quantities of alcohol—

$$HC_2\ H_5\ SO_4 + C_2\ H_5.\ OH = C_2\ H_5.\ O.\ C_2\ H_5 + H_2\ SO_4.$$

Every alcohol, by substitution of an alcohol radicle for the H. in the hydroxyl (HO), forms a corresponding ether. Thus methyl-alcohol (CH_3OH) yields $CH_3.O.CH_3$, which, being considerably cheaper than ethyl-ether, is sometimes substituted for it.

The B. P. ether contains about eight per cent. of alcohol and water; is a colourless, very volatile, inflammable liquid, with a peculiar etherial odour. Its spec. grav. is ·735. It boils at 105° F.; yields a vapour two and a half times heavier than air, but half that of chloroform; is miscible with alcohol in all proportions, and is soluble in ten volumes of water. It readily dissolves fats, volatile oils, balsams, resins, and, next after chloroform, is the best solvent for alkaloids.

Absolute or pure ether, free from alcohol and water, is prepared by washing the commercial ether with water, and distilling from calcium chloride and recently calcined lime. Its specific gravity is ·720; it boils at 95° F.; remains liquid at − 146° F.; but below that, solidifies in shining plates.

Actions and Uses.—Ether, in poisonous doses, is an inebriant narcotic. It kills by paralysis of respiration. The vapour inhaled produces anæsthesia. It is given by the mouth as a stimulant, carminative, and antispasmodic. It is applied externally as a refrigerant and local anæsthetic, and is also an antiseptic and a solvent for fats, oils, alkaloids, etc.

General Actions.—Applied to the skin, ether evaporates and **abstracts heat.** Repeated applications produce **local anæsthesia,** which, if maintained too long, the frozen part may be killed, and a slough formed. When swallowed, it **stimulates** the mucous surfaces of the mouth and alimentary canal, increasing secretions and movements, and hence developing carminative and antispasmodic actions. It is readily absorbed, especially in vapour, from the lungs. Small doses stimulate the nerve-centres and circulation. Large doses, after brief, slight stimulation, cause depression and anæsthesia—first of the brain centres, next of those of the spinal cord, and eventually

of those of the medulla (p. 46). Death results from paralysis of respiration. It is removed by all the excreting channels.

Ether, inhaled in tolerably concentrated form, **anæsthises horses** in three minutes, without much excitement, and the effects may be safely maintained for half an hour or longer. A donkey was fully affected in four minutes, another in five minutes, and a third in three minutes and a half, the last remaining insensible to pain for about half an hour (*Veterinarian*, 1847).

Ether has the disadvantage of having a more disagreeable taste than chloroform. As it has to be given in more concentrated form, it is also more irritating. Larger doses have to be used. Its vapour is dangerously inflammable. It is, however, less liable to paralyse the heart or vaso-motor centre. Ether and chloroform may be used together (p. 337); or, when anæsthesia is produced by chloroform, the effects may be maintained by ether. Ether is preferable when heart-action is feeble, where the anæsthesia has to be kept up for a considerable period, where operations likely to be attended with collapse are undertaken, and in dogs in whom cardiac failure not infrequently occurs during chloroform anæsthesia.

Ether **resembles** alcohol in its twofold stimulant and narcotic action; but it acts more promptly, its effects pass away more quickly, and, being volatile, its anæsthetic property is greatly more marked. Ether is a more powerful stimulant than acetate of ethyl or spirit of nitrous ether, neither of which are used as anæsthetics. Its stimulant properties ally it to oil of turpentine and the other volatile oils.

MEDICINAL USES.—Ether, diluted with a little spirit and water, is a prompt and effectual **carminative** in indigestion in all animals. It checks undue gastric fermentation, expels flatulence, and overcomes irregular violent gastro-intestinal movements (p. 45). This **antispasmodic** effect in many colic attacks in horses is increased when the stimulant is conjoined with such anodynes as opium, Indian hemp, or belladonna. Ether is sometimes given for the expulsion of intestinal worms, and especially of ascarides, which, when in the rectum, are readily dislodged by enemata of diluted ether. Such enemata also relieve spasmodic affections of the intestines.

As a prompt and powerful **diffusible stimulant,** ether is useful in collapse, whether caused by shock, hæmorrhage, or exhausting disease. Along with alcohol, it is used in cases of puerperal apoplexy in cows, and in such cases, when the patient is unable to swallow, it is advantageously given hypodermically. Chills and shiverings, which usher in many attacks of disease, are sometimes checked by a dose or two of ether. It equalises irregular circulation, restores imperfect action of the skin and kidneys, and gives tone to the enfeebled heart. Hard-worked horses, especially in towns, prostrated by catarrhal fever, are thus benefited even from the outset of the attack by ether, given with salines. In convalescence from inflammatory and exhausting diseases in all classes of patients, conjoined frequently with aromatics and bitters, it improves the appetite, strengthens the feeble pulse, and sometimes allays cough.

As a stimulant, it may be safely persisted with, wherever it reduces the number and increases the strength of the pulsations, lowers excessive temperature, and promotes secretion. It should be avoided where there is much vascular excitement and inflammatory fever.

As an anæsthetic, it is used for the same purposes as chloroform, and is administered in the same manner and with the same precautions (p. 335).

Local anæsthesia is usually induced by applying the ether from a spray producer. For such purposes the ether must be tolerably pure, for water, if present, gets frozen, and blocks the tube of the instrument. About an ounce usually suffices for the painless opening of abscesses and fistulæ, or for neurotomy or tenotomy. The effects, however, are more superficial and transient than those of cocaine, and are more apt to be followed by irritation and reaction, which retard healing of surgical or other wounds.

DOSES, ETC.—The B. P. ethyl-ether, containing eight per cent. of alcohol and water, is generally used for medicinal and pharmaceutic purposes; but good methyl-ether, on account of its cheapness, is sometimes substituted. **As a stimulant,** horses take f℥i. to f℥ii.; cattle, f℥ii. to f℥iii.; sheep and pigs, fʒii. to fʒiv.; dogs, fʒss. to fʒi. It is administered in cold water or diluted spirit, is sometimes sweetened with sugar or

treacle, or flavoured with aromatics. Combination with opium, Indiam hemp, or belladonna, increases its antispasmodic and anodyne effects. Where immediate results are required, as in violent attacks of colic, or in collapse, it is administered hypodermically.

As an anæsthetic, ether made from ethyl-alcohol is generally preferred. The larger animals take f℥iii. to f℥viii.; the lesser, fʒiv. to f℥i.

Spirit of Ether, or spiritus ætheris, is a mixture of one part ether and two rectified spirit, and is used as a stimulant and antispasmodic.

Etherial Oil, oleum ætherum, or oil of wine, is an oily, yellow, neutral liquid, with a bitter taste and aromatic odour, soluble in ether and alcohol, produced towards the close of the distillation of ether, containing ether mixed with various hydrocarbons, and possessed of anodyne and hypnotic qualities.

Spiritus Ætheris Compositus, or Hoffman's anodyne, consists of oil of wine, 3 parts; ether, 64; rectified spirit, 128.

Acetic Ether, or acetate of ethyl ($C_2H_5.C_2H_3O_3$), is prepared by distilling rectified spirit with sodium acetate and sulphuric acid. It is a transparent colourless, neutral liquid, of an etherial, acetous odour and taste. Its actions nearly resemble those of ether. It is used as a stimulant, carminative, and antispasmodic, but is unsuitable as an anæsthetic.

Collodion is prepared by mixing one part of gun-cotton with 36 of ether and 12 of rectified spirit. The solution, preserved in well-corked bottles, is clear, colourless, inflammable, evolves a strong etherial odour, and, on exposure to the air, dries rapidly, leaving a thin transparent film, insoluble in water or spirit. It is hence a useful substitute for sticking-plaster; repeated applications are laid on with a fine brush at intervals of a few minutes, and produce a protective covering, holding together the edges of slight wounds. The flexible collodion adheres still more firmly, gives support without splitting or cracking; is made by mixing 48 parts of collodion, 2 parts Canada balsam, and 1 part castor oil; and is kept in well-corked bottles. A styptic, antiseptic protective is made by thoroughly mixing with 100 parts of collodion 5 parts each of carbolic, tannic, and benzoic acids.

As a stimulating antiseptic protective for abraded skin or mucous surfaces, and notably for sore teats in cows and ewes, 100 parts of collodion are mixed with 2 of glycerin and 1 of carbolic acid. Collodion is occasionally used for coating boluses, but it is now greatly more important in photography than in pharmacy or surgery.

EUCALYPTUS.

EUCALYPTUS. The leaves of Eucalyptus Globulus, or blue gum tree, collected from rather old trees.

OLEUM EUCALYPTUS. The oil distilled from the fresh leaves of Eucalyptus Globulus, E. amygdalina, and probably other species of Eucalyptus. B. P. *Nat. Ord.*—Myrtaceæ.

The leaves and flowerbuds of various Myrtaceæ, such as cloves, pimenta, myrtle, and cajeput, as well as Eucalyptus, yield when distilled antiseptic volatile oils. The rapidly-growing Eucalyptus trees, indigenous to the Australian colonies, are now largely cultivated in many temperate regions for the purpose of preventing malarial fevers.

Eucalyptus oil, which is also called Eucalyptol, is colourless or pale straw-coloured, darkening by exposure; it has an aromatic odour, and a spicy, pungent taste; it is soluble in about its own weight of alcohol. Its antiseptic powers increase as it undergoes oxidation by keeping. It appears to contain **terpene** ($C_{10} H_{16}$), **cymene** ($C_{10} H_{14}$) and **an oxygenated product** ($C_{10} H_{16} O$).

ACTIONS AND USES.—The oil is **antiseptic,** and in large doses **irritant;** it is used both internally and externally as an antiseptic and stimulant; it resembles oil of turpentine and other volatile oils. Its antiseptic and antipyretic actions ally it with quinine. Some experimenters consider that it is fully as effectual as carbolic acid in destroying bacteria. It arrests the movements of the white blood corpuscles. It is a local irritant, producing, when evaporated from the skin, redness and vesication. When swallowed, it stimulates, and in large doses irritates, the alimentary mucous membrane. It is absorbed, paralyses the nervous centres, enfeebling respira-

tory and cardiac actions, and killing by respiratory arrest. It is excreted by the lungs and kidneys.

It is used as a gargle and inhalation to check excessive quantity and arrest fœtor of nasal, pharyngeal, and bronchial secretions. It is administered in protracted cases of strangles, influenza, and purpura in horses, septicæmia in all animals, and in distemper in dogs—in all such cases being usefully combined wtth quinine, ethers, and alcohol. In surgical cases it is sometimes substituted for carbolic acid. In fœtid uterine discharges, eucalyptol injections or pessaries are useful.

Doses, etc.—Horses and cattle take f℥i.; dogs, ♏ii. to ♏iv., dissolved in diluted spirits, mucilage, or milk. For external purposes, it is dissolved in oil or cocoa butter, and is often usefully conjoined with iodoform.

EUPHORBIUM.

An acrid resin obtained from Euphorbia resinifera (Berg.).
Nat. Ord.—Euphorbiaceæ.

The Euphorbiaceæ include the shrubs yielding croton, castor oil, the Brazilian tree producing danda or assu juice, and cascarilla bark. The cactus-like plants yielding medicinal euphorbium grow in the kingdom of Morocco, and in the region skirting the Atlas range. From incisions made into their angular, jointed, prickly stems and branches, an acrid, milky, resinous juice exudes, and concretes in irregular, dull-yellow tears, which are gathered in September, are about the size of large peas, often hollow, and perforated with little holes. Euphorbium has an acrid, persistent taste, is without odour; but its minutest particle in contact with the nostrils provokes immediate violent sneezing. The powder is grey, and insoluble in water; but its active resinous principle dissolves in alcohol, ether, and oil of turpentine. When heated, it melts, swells up, and burns with a pale flame and an agreeable odour. It contains 38 per cent. of an amorphous, **acrid resin** ($C_{10}H_{16}O_2$); 22 of the colourless, tasteless **euphorbon,** allied to lactucerin, a constituent of lettuce (*Flückiger and Hanbury, Pharmacographia*).

Actions and Uses.—Euphorbium is an irritant and pustulant. Introduced into the stomach or areolar tissues, rubbed into the skin, or inhaled into the nostrils, it causes violent and sometimes fatal inflammation. Two ounces given internally caused fatal gastro-enteritis in a horse; four drachms retained in the stomach of a large dog had the like effect in twenty-six hours. So intensely irritating is euphorbium, that the workmen employed in grinding it, although wearing masks or handkerchiefs over their faces, often suffer severely from headache, inflammation of the eyes, and sometimes even delirium.

It is occasionally added to blisters; but, especially in horses and dogs, it is apt to inflame the deeper layers of the skin, destroy the hair roots, and induce sloughing and blemishing. Hence it should be used sparingly, if at all. Unlike cantharides, it has no tendency to act on the kidneys.

FERN ROOT.

The rhizome, with the persistent bases of the petioles of Aspidium Filix-mas. Collected late in the autumn, divested of its scales, roots, and all dead portions, and carefully dried with a gentle heat. Should not be used if more than a year old (B. P.). *Nat. Ord.*—Filices.

The male fern grows wild throughout most temperate regions, on the sides of roads, and in open woods, especially where the soil is light. Its annual bipinnate fronds reach to the height of three feet; a section of their bases, examined by a pocket lens, discovers eight vascular bundles, whilst allied ferns contain only two (*Flückiger*). Its root stock is perennial, about a foot long and two inches thick, is scaly, tufted, greenish-brown, and firmly fixed in the ground by numerous black root fibres. The dried root has a disagreeable odour, and a sweet, astringent, nauseous taste. Besides the usual plant constituents, it contains about 4 per cent. of resin, 6 of a green fixed oil, a small amount of a volatile oil, with 8 per cent. of the crystalline **filicic acid** ($C_{14}H_{18}O_5$), which is its active constituent. The root is preserved in stoppered bottles, and the supply renewed annually. Deterioration from keeping,

and the substitution of the roots of inactive ferns, in great part explain the depreciatory accounts sometimes given of its efficacy. The green parts are most active, and should alone be used.

Actions and Uses.—Male shield fern is vermicide and laxative. It is one of the most effectual remedies for tapeworm, especially in dogs, sometimes dislodging the parasites within three hours. Kuckenmeister considers it quite as poisonous to the genus bothriocephalus. Dr John Harley believes that, like ergot, it stimulates the involuntary muscular fibres of any hollow viscus in which it is placed, and thus explains the vomiting and intestinal peristalsis which full doses produce when swallowed, and the contractions induced when it is injected into the urinary bladder (*Royle's Materia Medica*).

Doses, etc.—The powdered root is given to horses and cattle in doses of lb. $\frac{1}{2}$; sheep, ℥iij. to ℥v.; dogs and cats, ℥ii. (*Gamgee's Vet. Vade Mecum*). But the powder is inconveniently bulky, and less certain than the **liquid extract** or oil, which the B. P. thus directs to be made: "Pack two pounds of the male fern in coarse powder closely in a percolator; and pass four pints or a sufficiency of ether slowly through it until it passes colourless. Let the ether evaporate on a water bath, or recover it by distillation, and preserve the oily extract." These quantities yield three ounces of the oily extract, of which the dose for horses or cattle is f℥ij. to f℥iv.; for sheep, f℥i.; for dogs or cats, ♏x. to f℥j. It is given sometimes with half a dose of turpentine in a little oil or gruel, when the bowels have been emptied by a laxative and several hours' fasting. Professor Williams states that the liquid extract, with half a dose of areca-nut, constitutes the most effectual remedy for tape-worm in dogs. If the parasite is not expelled, the medicine may be repeated in three days.

GALLS.

Galla, Oak Galls. Excrescences on Quercus lusitanica Var infectoria, caused by the puncture and deposit of an egg or eggs of Cynips Gallæ tinctoriæ (B. P.) *Nat. Ord.*—Cupuliferæ.

Galls, or gall-nuts, found on the young branches and shoots of a shrubby species of oak, are caused by the female of a species of Cynips, which punctures the buds, and deposits its ova. Irritation follows, the punctures become surrounded by woody matter, and within this globular abode the larva develops, until, about July, it becomes a perfect fly, perforates its cell, and escapes. Before this the galls ought to be gathered. The best commercial variety, known as Levant galls, is imported from Syria, Smyrna, and Constantinople; the light, hollow Chinese, Japanese, or East Indian galls, are yielded by the Rhus simialata; large Mecca galls, called Dead Sea apples, are imported from Bussorah. Home-grown galls from the common oak (Quercus robor) are in some seasons abundant throughout the southern and midland counties of England, but seldom contain more than half the tannic acid found in the foreign.

Galls vary from the size of a bean to that of a hazel-nut, are round, hard, and studded with tubercles; of a bluish-grey colour externally, and yellow within. The central hollow, in which the insect may generally be found, is sometimes empty, from the death of the larva, or its escape in a perfect form, when the small hole may be found through which the creature has liberated itself. These white galls have a smoother, duller appearance, a lower density, lighter colour, and less astringency, than the ordinary or blue galls. Galls are easily reduced to a yellow-grey powder devoid of odour, but having a powerful astringent taste. The active principles are dissolved by 40 parts of boiling water and still less proof spirit. Iron persalts, added to a watery solution, slowly precipitate the dark-blue or black iron tannate, the basis of writing ink. An aqueous solution of gelatin throws down a grey flocculent precipitate of tanno-gelatin—the essential principle of leather. These reactions, and other important properties, depend on the presence of tannin or gallo-tannic acid, which, according to the quality of the galls, ranges from 15 to 70 per cent., and is associated with about 3 per cent. of gallic acid.

Tannic Acid, tannin, or digallic acid ($C_{13}\ H_9\ O_7.\ CO_2\ H$), is the principle to which oak-bark galls, logwood, and many vegetable astringents owe their properties. The tannic acid

from these several sources has, however, somewhat different characteristics, and generally receives such special designations as gallo-tannic, cincho-tannic, catechu-tannic acids. Gallo-tannic acid is prepared by softening powdered galls by keeping them for two days in a damp place, digesting them for several hours simultaneously with water, which dissolves the tannic acid and ether, which dissolves colouring matter and gallic acid. The mixture, filtered and allowed to stand, forms into two layers, and the lower, carefully evaporated, yields tannic acid. It occurs in pale yellow vesicular masses, or thin glistening scales; has a strongly astringent taste and an acid reaction; is readily soluble in water and dilute alcohol, but very sparingly soluble in ether. The aqueous solution gives a yellow-white precipitate with gelatin, and blue-black precipitates with iron persalts. It is also precipitated by, and hence is incompatible with, the alkalies and their carbonates, with most metallic salts, the mineral acids, and the vegetable alkaloids. It leaves no residue when burned with free access of air. Exposed to air and moisture, in the presence of a ferment, or boiled with diluted sulphuric or hydroohloric acid, it is decomposed, yielding gallic acid and glucose; and hence is termed a glucoside.

Gallic Acid, or tri-hydroxy-benzoic acid ($C_6H_2(HO)_3.CO_2H$) is prepared by keeping moistened powdered galls in a warm place, when fermentation occurs; one equivalent of tannic or digallic acid, assuming one of H_2O, produces two of gallic acid, which is dissolved by boiling water, and crystallised. It may also be prepared by boiling tannic acid with dilute sulphuric acid. It occurs in acicular prisms, or silky needles, which are colourless or pale fawn. It requires for solution about 100 parts of cold water and three of boiling water; but is more soluble than tannic acid in alcohol and ether. Its aqueous solution gives a blue-black precipitate with iron persalts. Unlike tannic acid, it is not precipitated by gelatin, hydrochloric, or sulphuric acids. Lime water browns tannic acid slowly, browns gallic acid immediately, and with pyrogallic acid yields a purple red, which becomes brown as it absorbs oxygen (*Attfield*).

Actions and Uses.—Galls, tannic and gallic acids, differ

only in the degree of their action. They are astringent and styptic. Powdered galls are about one half the activity of tannic acid. Gallic acid does not coagulate gelatin or albumin, and hence exerts less topical astringency than tannic acid.

Tannic acid may be taken as **the type of the group.** It has little effect on the unbroken skin; but on abraded skin surfaces and mucous membranes it coagulates albumin, causes dryness and tanning, with some contraction of the soft textures. Unlike salts of lead, silver, or other mineral astringents, it does not contract capillary vessels. It paralyses the sensory nerves, and diluted solutions hence relieve irritation of mucous and skin surfaces. It coagulates blood, and hence arrests bleeding. It is slowly and partially absorbed into the blood; but its astringency is in great part neutralised by combination with albuminoids, and its general astringent and hæmostatic powers have been overstated (p. 70). It is excreted as gallic acid, or as some oxidised product thereof.

Medicinal Uses.—Tannic acid and galls in powder, solution, or spray, are applied in cases of stomatitis and relaxed conditions of the pharynx and throat. In diarrhœa and dysentery they are prescribed with chalk, acids, aromatics, and opium. For these purposes the tannin-containing catechus and kino are often preferred. For arrest of internal hæmorrhage, neither tannic nor gallic acid is so effectual as ergot, iron perchloride, or lead acetate and opium. Dr Stockman's investigations, reported in the *British Medical Journal*, December 1786, have shown that gallic acid, even in full doses, has no special general astringent action. Both tannic and gallic acids are used as antidotes for poisoning by alkaloids; but in combating metallic poisoning they are not so serviceable as eggs.

Externally, tannic acid is used with glycerin and water in the weeping stages of eczema; as an astringent wash with opium in prolapsus of the uterus and rectum; and it often allays the discharge and irritability of otorrhœa, which is not uncommon in dogs. It is applied to soft ulcerating bleeding surfaces. For piles in dogs, gallic acid is used as an ointment, opium being added if there is much irritability; and such applications are often advantageously alternated with calomel ointment.

DOSES, ETC.—Of tannic acid horses take grs. xx. to ʒij.; cattle, ʒiij.; sheep and pigs, grs. xv. to grs. xxx.; dogs, grs. ij. to grs. xv. Gallic acid is used in the same doses; powdered galls in about double these doses. **Glycerins** of tannic and of gallic acids are made by stirring one part of acid with four of glycerin, and assisting solution with gentle heat, and are soothing astringents, which may be conveniently diluted with water as required. **Gall ointment** is made with two parts powdered galls, one opium, and twelve lard or vaselin. **Styptic colloid** is usually prepared with one of tannin and eight of alcohol, mixed with four of collodion. **Pyrogallic acid** is an antiseptic, astringent, and caustic, recommended in cases of psoriasis and lupus, and for tanning and shrivelling carcinomatous growths (p. 272).

GAMBOGE.

GAMBOGIA. Gamboge. A gum-resin obtained from Garcinia Hanburii (G. Morella, var. pedicillata). (B. P.) *Nat. Ord.*—Guttiferæ.

Gamboge is the produce of a moderate-sized diœcious tropical tree; is imported from Singapore, Siam, and Ceylon; is obtained from incisions into the middle layer of the bark, or by breaking the leaves and branchlets, when the yellow milky juice exuding is collected in leaves, in cocoa-nut shells, or in joints of bamboo, is transferred into flat earthen vessels, and dried in the sun. It occurs in cylindrical yellow pieces or rolls, four to eight inches long, two to three inches in diameter, and in cakes; breaks easily with a smooth conchoidal glistening orange-yellow fracture, is odourless, but has an acrid taste. It is feebly soluble in water, makes with it a yellow emulsion, and is soluble in alcohol and ether. It consists of 15 to 20 per cent. of soluble gum, about 80 of an active orange-yellow **resin** and **gambogic acid**. It is largely used as a pigment.

ACTIONS AND USES.—It is a powerful irritant and drastic hydragogue cathartic, inferior in activity only to croton and elaterium.

It undergoes solution in the alkaline intestinal juices, and in large doses causes gastro-enteritis. Moiroud gave **horses** six

to twelve drachms, and found the dejections frequent and fluid, the pulse irregular, the animal shivering and anxious. Two drachms killed a **sheep,** two ounces and a half had little effect upon a cow, but five ounces caused dysentery, which continued for seventeen days.

Gamboge is too drastic and uncertain to be safely given either to horses or dogs. It causes profuse watery discharges and increased peristalsis, and although Professor Rutherford's experiments demonstrate that it has no special stimulant action on the liver, like all purgatives acting on the small intestines, it is a cholagogue, in the sense that it promptly moves onwards the bile in the duodenum, and thus prevents its reabsorption. It has no direct vermicide effect, but produces diuresis, especially when given in small doses dissolved in alkalies. **For ruminants,** it is safe, speedy, and manageable when in combination with other purgatives. Half a pound each of Epsom and common salt, and an ounce of gamboge, proves a prompt and effectual purgative in indigestion, fardel-bound, and parturient apoplexy of cattle. Although neither gamboge nor aloes is particularly certain when used alone, an ounce of each, rubbed down and given in solution, proves an effectual purge for ordinary cattle cases.

DOSES, ETC.—For cattle, ℥ss. to ℥j.; for sheep, grs. xx. to grs. xxx; given in combination with other purgatives, and in solution.

GELATIN—GLUE.

Nitrogenous matters extracted by the action of hot water from bones, tendons, and animal membranes.

Gelatin is chiefly made from damaged hides and skins, and their parings; also occasionally from bones, limed, cleaned, and boiled to remove fatty matters, and then crushed and steamed in a partial vacuum **Glue,** a coarse variety of gelatin, is made from similar materials less carefully purified; size is an inferior, weaker variety of glue; **isinglass,** a natural colourless gelatin, is prepared from the air-bladder of the sturgeon, and various species of Accipenser; **chondrin** is the gelatinous matter extracted from cartilage; **ossein,** the title given to that

obtained from bones. Gelatin, when dried, is hard and tough; varies in colour according to its purity; forms a viscid tremulous mass, even when one per cent. is dissolved in water and allowed to cool; and is precipitated from watery solutions by tannic acid.

ACTIONS AND USES.—Gelatin, although a product of the disintegration of albuminoid tissues, does not build up the albuminoid or even the gelatinous tissues; but being tolerably easily digested, it appears to **economise** the more valuable **albumin.** Men, dogs, and even horses, recovering from exhausting disease, in which disintegration and excretion of albuminoids is great, exhibit the dietetic value of gelatin when it is given as soup, and along with fats or hydrocarbons. As a demulcent, it has the disadvantage of becoming hard and dry, and hence is not very suitable as a permanent sheathing for irritable surfaces.

Glue is employed for securing the broken horns of cattle, and occasionally for making **adhesive plasters.** For closing wounds, two pieces of stout cloth are cut so as to leave a number of tails with uncut margins of several inches, and are smeared with melted glue, usually mixed with pitch, and applied, one on either side of the wound, with the uncut margins towards each other. When the plaster is dry, these approximating uncut margins are sewed together, while, to prevent displacement from the movements of the skin, narrow strips of calico moistened with glue are then applied in various directions over the injured spot. Large wounds are thus secured by non-professional persons who cannot use sutures or needles. When wounds are sewed or sutured, such plasters are sometimes also useful in keeping the parts in position, giving support, and preventing the annoyance of flies; a dependent opening must, however, be left for egress of discharges. They are sometimes effectual in reducing and retaining umbilical hernia, both in calves and foals; and in these, as in other cases, the chief requisites for their successful application are to cut the cloth into ribbons or tails, to smear both cloth and skin with the melted glue, and keep the plaster smooth and firm until it is thoroughly dry: the admixture with the glue of one-third or one-half of pitch increases adhesiveness. The

familiar **court sticking-plaster** consists of a strong solution of isinglass painted over thin silk. In pharmacy, gelatin is used for clarifying or fining, and as a neat and cleanly envelope for pills and boluses.

GENTIAN.

GENTIANÆ RADIX. The dried root of Gentiana lutea. (B. P.)
Nat. Ord.—Gentianaceæ.

The Gentiana lutea, or yellow gentian, has a perennial, often forked root, and an annual herbaceous stem, which rises three or four feet high, and bears axillary whorls of yellow flowers. It abounds in most parts of temperate Europe, thrives best between 3000 and 5000 feet above the sea-level, and is extensively cultivated in the mountainous districts of the Alps, Vosges, and Pyrenees. All parts of the plant are bitter and tonic, but the root alone is officinal. It is brought to this country in bales, chiefly from Switzerland, the Tyrol, and Auvergne, usually by way of Marseilles and other Mediterranean ports. It occurs in cylindrical, usually more or less branched, often twisted, pieces, or in longitudinal slices, marked by transverse annular wrinkles and longitudinal furrows, and varying in length from a few inches to a foot, and in thickness from half an inch to an inch. The bark is thick, reddish, and separated from the central woody yellow portion by a zone of cambium. It has a peculiar aromatic and rather disagreeable odour; and a taste at first sweet, but afterwards strongly and permanently bitter, but without astringency. When moist, it is tough and flexible; when dry, brittle and easily pulverised. The powder is yellow, with a shade of brown, and readily yields its bitterness to water, alcohol, and ether.

Gentian root **contains** 12 to 15 per cent. of **uncrystallisable sugar,** which, in Southern Bavaria and Switzerland, is fermented into a drinking spirit, a large amount of pectin, a little volatile oil and fat, the yellow crystalline, **gentianin** or gentianic acid ($C_{14} H_{10} O_5$), which is inert; and about 0·1 per cent. of an intensely bitter glucoside, **gentiopicrin** ($C_{20} H_{30} O_{12}$), obtainable in colourless crystals, which are soluble in water and

spirit, rendered yellow by cold potash and soda solutions, and by hot ammonia solution; dissolved, without colouration, by cold concentrated sulphuric acid; but such solution, when gently heated, changes to carmine red, and on addition of water, deposits grey flocculi. In its actions gentiopicrin is nearly allied to quinine (*Phillips*).

Roots of other Gentianæ are frequently mixed with those of G. lutea; but this is not of much importance, since all are possessed of similar properties. Admixture, however, sometimes occurs of poisonous roots, such as monkshood, belladonna, and white hellebore, which may be distinguished by the absence of the pure bitter taste and bright yellow colour so characteristic of true gentian. Gentian powder, especially that met with abroad, is stated to be occasionally adulterated with yellow ochre, easily detected by heating the suspected specimen with a little sulphuric acid, filtering, and testing for iron.

Actions and Uses.—Gentian is a pure bitter, and is prescribed as a stomachic and tonic for all veterinary patients. It resembles calumba, chiretta, quassia, and hydrastis candensis or golden seal. As a tonic, it has been considered little inferior to cinchona; it is devoid of astringency.

Medicinal Uses.—Gentian improves the appetite and general tone. In **atonic indigestion** it is particularly useful amongst young animals, and in such cases is often conjoined with ginger and sodium carbonate. In relaxed and irritable states of the bowels, and where intestinal worms are suspected, after administration of a laxative, gentian and hydrochloric acid are often serviceable. For horses suffering from simple **catarrh,** few combinations are more effectual than an ounce of powdered gentian, two drachms nitre, with two ounces Epsom salt, dissolved in a pint of water, linseed tea, or ale, and repeated night and morning. In inflammatory complaints, after the first acute stage is passed, such a prescription also proves serviceable. Where the bowels are constipated or irregular, or febrile symptoms are insufficiently subdued, two drachms of aloes are sometimes conjoined with the gentian. Where more general tonic effects are sought, iron sulphate is alternated with the gentian and salines. An ounce of gentian, with an ounce of ether or sweet spirit of nitre, given three or four times daily

in a bottle of ale, proves an excellent stomachic and stimulating tonic in influenza and other epizootics; helps convalescence from exhausting disorders; and is a useful restorative for horses jaded, overworked, or suffering from loss of appetite or slight cold.

For **cattle** the above prescriptions are as serviceable as for horses, but require to be given in somewhat larger doses. For **sheep,** gentian is a very useful stomachic and bitter tonic, and when prescribed with salt arrests, for a time, the progress of liver-rot. Next after quinine, it is the best vegetable tonic for **dogs** prostrated by reducing disorders.

Doses, etc.—For the horse, ℥ss. to ℥i.; for cattle, ℥i. to ℥ij; for sheep, ʒi. to ʒiij.; for pigs, ʒss. to ʒi.; for dogs, grs. v. to xx., repeated twice or thrice daily. The carefully-prepared Pharmacopœia extract infusions and tinctures, flavoured with bitter orange-peel and aromatics, are little required in veterinary practice. The powder is prescribed in **bolus,** prepared with treacle, glycerin, and meal, or in **infusion,** made by digesting the powder during several hours in hot water, and decanting off the clear fluid. A small addition of proof spirit insures more thorough solution and better keeping.

GINGER.

Zingiber. The scraped and dried rhizome of Zingiber officinale. (B. P.) *Nat. Ord.*—Zingiberaceæ.

The Zingiber officinale, grown in many tropical countries has a biennial, creeping, fleshy, and nodulous rhizome, which gives off numerous descending short radicles, with several ascending annual leafy stems, reaching three or four feet in height, invested with alternate elliptical leaves, and terminated by spikes and raccines of purple flowers. For making **green** or **preserved** ginger, the rhizomes are gathered while still soft and juicy, and when about three months old. For other purposes they are taken up when about a year old, when the aerial stems have withered, but while the rhizome is still plump and soft. They are scalded to check vegetation, usually scraped to remove the brown wrinkled epidermis, and dried in the sun.

Properties.—Several sorts are recognised:—The Jamaica, in plump flat pieces or races, pale, bark stripped of epidermis, producing a light coloured powder, of superior quality; Malabar, or Cochin China, a little darker, but usually good; Bengal and African, imported both coated and uncoated, many samples of which are cheap and excellent; Barbadoes, in short thick races, retaining its brown corrugated epidermis. The unstripped descriptions are sometimes termed black gingers. The several varieties are in flat, irregular-lobed, knotted, zig-zag pieces, two to four inches in length, externally pale yellow, striated, and fibrous, breaking with a mealy, short, somewhat fibrous fracture, having a strong, agreeable aromatic odour, a warm, pungent taste, and dissolving in water and alcohol. To imitate the finer Jamaica ginger, inferior varieties are exposed to the action of sunlight, sulphurous acid, or calx chlorata; but such bleaching cannot impart the resinous structure or aroma which distinguish good specimens.

Ginger owes its taste to **a pungent resin,** its aroma to a **volatile oil,** and its medicinal and flavouring properties to both constituents, which are chiefly found in the delicate felted layer of skin lying between the starchy, mealy parenchyma and the brown horny external covering. As a condiment and medicine, Great Britain annually imports about 300 tons of ginger.

Actions and Uses.—Ginger is an aromatic stimulant, and is used as a stomachic and carminative in all patients, notably in cattle and sheep.

Blown into the nostrils, it increases nasal discharge; chewed, it reflexly augments the flow of saliva; administered internally, it promotes gastric secretion, digestion, and appetite. It is prescribed in atonic dyspepsia, often along with antacids and laxatives. Conjoined with purgatives, it diminishes their tendency to nauseate and gripe, and also somewhat hastens their effects. Allied to ginger, and belonging to the same natural family, are turmeric and galangal, the rhizomes of plants of Southern Asia.

Doses, etc.—For the horse, ʒiv. to ℥i.; for cattle, ℥i to ℥iij.; for sheep, ʒi to ʒij.; for pigs, ʒss. to ʒi.; for dogs, grs. x. to grs. xxx. A bolus is made with any suitable excipients;

the infusion is used sometimes sweetened with treacle or sugar; the B. P. tincture is prepared with 2½ ounces powdered ginger to a pint of rectified spirit, by maceration and subsequent percolation.

GLYCERIN.

GLYCERINE. Glycerinum. Glycerol. Tryhidric alcohol. Prophenyl hydrate. A sweet principle obtained by reaction of fat and fixed oils with aqueous fluids, and containing a small percentage of water. (B. P.) $C_3 H_5 (OH)_3$.

Glycerin was discovered in 1789, by Scheele, as a product in the manufacture of lead plaster; it occurs in small amount during the fermentation of sugar. It is chiefly obtained by **decomposing palm oil,** which consists of palmitin, in a still, by the action of super-heated steam, at a temperature of about 600° F. The crude product is freed from water by subsequent distillation. The decomposition occurring is represented as follows:—

$$\underset{\text{Palmitin.}}{C_3 H_5 (C_{16} H_{31} O_2)_3} + \underset{\text{Water.}}{3\ H O H} = \underset{\text{Glycerin.}}{C_3 H_5 (OH)_3} + \underset{\text{Palmitic acid.}}{3\ HC_{16} H_{31} O_2}$$

Glycerin likewise occurs as a by-product in the manufacture of soap and stearin candles. Fats yield, however, only ten per cent. of glycerin; and it does not now pay to extract it either from the soap or candle-maker's refuse.

PROPERTIES.—It is a clear, colourless viscid liquid, devoid of odour, sweet to the taste, oily to the touch, with a spec. grav. of 1·25. It is freely soluble in water and alcohol. It dissolves most substances which are soluble in water, as well as metallic oxides, alkaloids, and others which are not. It burns with a luminous flame, giving off irritating vapours of acrolein. Cautiously added to a mixture of equal measures of nitric and sulphuric acid, it produces nitro-glycerin—$C_3 H_5 (NO_3)_3$.

ACTIONS AND USES.—Glycerin is nutrient, demulcent, emollient, and antiseptic. It is a solvent for the fixed alkalies, for alkaloids and their salts, vegetable acids, etc. It is the basis of the group of emollient, antiseptic, and astringent

glyceryls or glycerines; is a frequent constituent of ointments and lotions, and a convenient menstruum for the administration of nauseous medicines.

It has the **nutrient** properties of cod-liver and other bland oils. It is slowly and partially absorbed. Small doses are eliminated by the kidneys, larger doses by the bowels, producing **laxative** effects. The addition to castor oil of $\frac{1}{8}$th part increases activity. It is sometimes used as a laxative enema. Given shortly before meals, it is useful in checking undue gastric fermentation, acidity, and flatulence, both in calves and dogs.

It neither evaporates, dries, or becomes rancid, and hence preserves and softens various organic substances, and is a useful **emollient.** But in an undiluted state it irritates the mucous, and even the skin surfaces, apparently from absorbing water. It is readily miscible with water, spirit, oils, and other drugs, forming with them emollient, antiseptic, or astringent dressings, used to soften, supple, or soothe dry, rough, scurfy, or irritated skin surfaces. It is the basis of many dressings for blisters and burns, for mud fever, cracked heels, and various forms and stages of eczema. **Glycerin of starch** is made by stirring and heating gently one part starch, three parts water, and five parts glycerin, and is used for aphthous and other eruptions about the mouth, nostrils, and udder, and as a soothing and drying dressing for erythema and the early weeping stages of eczema, especially in dogs. **The glycerins** of carbolic, gallic and tannic acids are prepared with one part of the acid and four of glycerin. Glycerin of alum is made with one of alum to five of glycerin. Similar antiseptic and astringent preparations are made with glycerin and borax, and also with glycerin and acetate and oxide of lead, with water to effect thorough solution. A handy antiseptic and astringent application is extemporised by mixing equal parts of glycerin and Goulard's extract: it is diluted as required, and used for erythematous and eczematous conditions of the skin.

Boro-glyceride, prepared by heating 92 parts glycerin and 62 boric acid, and used diluted with 20 to 40 parts water, is an effectual non-poisonous antiseptic, useful for relaxed and diphtheritic conditions of the throat, as a dressing

for wounds, for the preservation of food, and as a vehicle for applying carbolic acid, iodine, and iodoform.

For various itching, erythematous, and eczematous diseases, a **soothing, drying protective** is prepared by mixing, with the aid of gentle heat, three parts each of glycerin, gelatin, and water, with one of zinc oxide; and with such a mixture may be incorporated, as required, creasote, carbolic acid, resorcin, or naphthol.

GUM ARABIC.—GUM TRAGACANTH.

ACACIÆ GUMMI. A gummy exudation from the stem and branches of Acacia Senegal, and from other species of Acacia. (B. P.)

TRAGACANTHA. Gum tragacanth. A gummy exudation obtained by making incisions in the stems of Astragalus gummifer, and some other species of Astragulus. (B. P.) *Nat. Ord.*—Leguminosæ.

Gum is obtained from many plants, notably from various species of Acacia. These are stunted, withered-looking trees, occurring in tropical countries, most prolific when old and stunted, and during dry, hot seasons. In June and July, from natural cracks or artificial incisions in the bark, a viscid juice exudes, and concretes into round masses or tears, varying in size from a pea to a walnut, brittle, usually shining, colourless, yellow, or brown, odourless, and of a bland, sweet taste. Gum dissolves in water, forming an adhesive, viscid fluid or mucilage.

Gum Acacia, or **Gum Arabic,** is chiefly collected in Kordofan, in Eastern Africa, and forwarded from Alexandria. When imported, it is picked and sorted, usually into three different qualities, distinguished by the size, colour, and transparency of the tears. It is soluble in about its own weight alike of hot and cold water, is insoluble in and incompatible with alcohol, ether, and oils. Boiled with dilute sulphuric acid, it is converted into gum sugar; oxidised by nitric acid, it is converted into mucic acid. It consists of **arabin** or arabic acid (C_{12} H_{22} O_{11}), which occurs in gum as arabate of calcium, magnesium, and potassium.

Gum Senegal is similar to gum Arabic, but less brittle, and

requires four or five parts of water to dissolve it. The East Indian gums are generally dark-coloured, more difficult of solution, and less valuable. The gums of Australia and the Cape, now imported in considerable quantity, are also inferior to gum Arabic.

Gum Tragacanth is collected in Asia Minor, mostly exported from Smyrna, and occurs in thin, semi-transparent, tough, horny white-grey or yellow lamellæ or plates, and marked with arched or concentric ridges. It is tasteless and odourless. Although readily soluble in boiling water, it is sparingly soluble in cold water, which swells it into a jelly, containing starch, as is indicated by the iodine test. Tragacanth contains a neutral gum, **bassorin,** which, gelatin-like, swells up, is not dissolved either by hot or cold water, but is soluble in alcohol.

British gum or dextrin ($C_6 H_{10} O_5$), much used in calico-printing, is made by treating starch with dilute nitric acid, drying it, and heating it to about 240° F.

Actions and Uses.—Gums are the least nutritive of the carbohydrates; when swallowed, they are dissolved by the alimentary secretions, and in part converted into sugar. They are occasionally prescribed for ensheathing the mucous surfaces in catarrh and diarrhœa, and as demulcent injections in inflammation of the bowels and bladder, but for veterinary purposes are usually superseded by well-boiled linseed or starch gruels. For making emulsions, electuaries, and boluses, gums have the disadvantage of speedily drying and hardening.

Doses, etc.—Gums may be taken almost *ad libitum*. Horses and cattle may have ℥ij. to ℥iij.; foals, calves, and sheep, ℥i.; and dogs, grs. xx. to grs. xl.

HELLEBORE.

Black Hellebore. Dried rhizome and radicles of Helleborus niger. *Nat. Ord.*—Ranunculaceæ.

The Helleborus niger, Christmas rose, or bear's foot, is cultivated in this country, is indigenous to many parts of

continental Europe; the chief supplies come from Germany. It is herbaceous, one to two feet high, with numerous digitated, dirty-green leaves, flowers which appear in January and February, and a perennial, black, knotted, scaly rhizome, one to three inches long and scarcely half an inch thick, from which descend numerous dark-coloured radicles, about the thickness of goose-quills, having a faint, unpleasant odour, and an acrid bitter taste. The plant generally is acrid, but the rhizome and rootlets are most active. The rhizomes of Helleborus viridis and fœtidus, often mixed with those of the niger, are very similar in action. Hellebore contains a bitter, neutral, non-volatile, irritant glucoside, **helleborin,** $C_{36} H_{42} O_6$; a slightly acid irritant glucoside, **helleborein,** $C_{26} H_{44} O_{15}$; other crystalline principles; and an organic acid, probably equisetic (*Flückiger*).

ACTIONS AND USES.—Black hellebore is an acrid irritant, but scarcely so active as veratrum album or white hellebore. It is emetic, a drastic purgative, an anthelmintic, and topical irritant.

Full doses produce, in all animals, gastro-enteritis, with cardiac depression. Two drachms swallowed by a medium-sized dog killed him in a few hours, and smaller quantities have proved fatal in a shorter time when applied to wounds (*Christison*). Two or three drachms produce in horses colic and enteritis; two or three ounces are invariably fatal in forty to fifty hours; one to three drachms induce similar effects among sheep and goats (*Hertwig*). On account of its violence, it is seldom prescribed in regular practice. Even for promoting discharges, and as a constituent of blistering ointments, it must be used with caution, as it is liable to act with unexpected violence. An ounce of powdered hellebore and two ounces of alum, dissolved in a gallon of hot water, are used to destroy caterpillars infesting gooseberry, rose, or other trees.

HEMLOCK.

Hemlock Leaves. Conii folia. The fresh leaves and young branches of Conium maculatum; gathered from wild British plants when the fruit begins to form.

Hemlock Fruit. Conii fructus. The fruit of Conium maculatum, gathered when fully developed, but while still green, and carefully dried. (B. P.) *Nat. Ord.*—Umbelliferæ.

Hemlock grows wild in hedges and waste places in most parts of Europe. When one year old, it has a small slender root, and a few leaves lying flat on the ground. During its second year's growth, when it is collected for use, the root is one or two feet long, an inch in diameter, white, and fusiform. The flowering stem is two to five feet high, round, hollow, jointed, smooth, branching towards the top, and covered with purple spots. The large bi- or tri-pinnate leaves are glabrous and dark-green, have clasping petioles of varying length, a nauseous, bitter taste, and a strong, peculiar odour, which is characteristic of all parts of the plant, and aptly compared to that of mice or of cats' urine. The flowers are small, white, and, like those of the other plants of the family, arranged in umbels or clusters. The fruit resembles that of anise, is of a brown colour, about $\frac{1}{8}$th of an inch in length, broadly ovate, separable into two mericarps, each marked with five ribs. It is mostly imported from Germany, should be gathered before it is fully ripe, when it has attained its full size, but is still soft and green: 9 lbs. of such fruit produce an ounce of coniïne, which, with an essential oil, is found stored chiefly in cubical cells in the endocarp. Dried in thin layers in a warm darkened room, at a temperature of 80° F., and kept in close-fitting tin canisters, the fruit may be preserved for a year. When fully ripened it contains less coniïne, and besides keeps badly.

The leaves should be gathered in July, when the fruit begins to form, are rapidly dried in stoves at about 120° F., and preserved in tins, bottles, or jars, excluded from light.

By drying, they lose three-fourths of their weight, and, according to Dr Harley, one-half of their volatile principle, of which scarcely a trace remains after they are kept twelve months (*Royle's Mat. Med.*). Long-keeping of the fruit and leaves, and their exposure to temperatures exceeding 120° F., account for the inertness of many hemlock preparations.

Besides a bitter, nauseous oleo-resin, and a non-poisonous volatile oil, the plant contains the volatile oleaginous paralysing alkaloid **coniïne** ($C_8 H_{15} N$), which may be obtained by distilling any portion of the plant with dilute caustic potash. It can also be prepared from butyric aldehyde by the action of ammonia. It has the specific gravity ·89, boils about 334° F., rapidly oxidises into a brown semi-solid, has an intense odour of mice, a peculiar acrid taste, is sparingly soluble in water, but readily dissolved by alcohol and ether. Nitric acid, dropped on coniïne, produces a blood-red colour; sulphuric acid, a purple red, passing to olive-green. Hemlock also contains a solid crystallisable alkaloid, of less activity, called **conhydrine** ($C_8 H_{17} N O$). Associated with these in variable quantity, but differing materially in its actions, is **methyl-coniïne,** $N C H_3 (C_8 H_{14})$.

The leaves and fruit of hemlock are distinguished by their appearance, and, if triturated with diluted caustic potash solution, evolve the characteristic odour of mice. Fool's parsley, Æthusa Cynapium, water hemlock, or cowbane (Cicuta virosa), the fine-leaved water hemlock (Phellandrium aquaticum), the water parsnip (Œnanthe crocata), are Umbelliferæ with physiological effects similar to those of conium maculatum, and when freely eaten have poisoned most of the domestic animals (*Professor Gamgee's Veterinarian's Vade Mecum*). Of wholesome dietetic Umbelliferæ, parsley, parsnip, and celery are illustrations. The natural family is rich in aromatic carminative seeds (p. 224).

Actions and Uses.—Hemlock and its alkaloids, coniïne and conhydrine, paralyse the extremities of motor nerves and of the vagus, quieting motor irritability. They are used as anodynes and antispasmodics. Applied locally, they also paralyse the ends of sensory nerves. Methyl-coniïne paralyses the motor tract of the spinal cord, impairing reflex action.

General Actions.—Hemlock was the state poison of the Athenians, the death potion of Socrates. Its **paralysant** action is specially exerted on the **ends of motor nerves,** although when locally applied it has similar effects on sensory nerves. It causes a weak and staggering gait, the hind extremities being first affected. Full doses subsequently paralyse the motor centres of the brain and spinal cord. It has no direct effect on circulation, secretion, excretion, or on intelligence. Convulsions occasionally occur in warm-blooded animals, frequently depending upon the presence of methyl-coniïne, which, as indicated, acts upon the spinal cord, and paralyses reflex action. Death results from paralysis of the muscles of respiration. It is **excreted** mainly by the kidneys, possibly in part by the lungs. It resembles curare (p. 366). Its physiological **antagonists** are nux vomica, strychnine, and other tetanisers.

Toxic Actions.—Dr John Harley and Mr Fred. Mavor gave a two-year-old thoroughbred colt doses of six, eight, and twelve ounces of succus conii without appreciable effect. Sixteen ounces, corresponding to a pound of the fresh leaves, produced in twenty-five minutes dulness and stupidity, drooping and swollen eyelids, but no change in the pulse or pupils. A few minutes later the colt went down upon his knees, appeared to require special efforts to keep himself on his legs, stumbled, and walked slowly when led, but in two hours the symptoms had entirely disappeared (*The Old Vegetable Neurotics*, by Dr John Harley, 1869). Moiroud poisoned a horse with half a pound of the dried leaves given as a decoction, and observed nausea, spasmodic twitching of the muscles of the extremities, cold sweats, dilatation of the pupils, and dulness. Asses in Italy eating hemlock are sometimes so thoroughly paralysed that, supposing them to be dead, the peasants have actually begun to skin them (*Matthiolus*).

Cattle poisoned lie as if lifeless, with slow, feeble pulse, cold extremities, and dilated pupils (*Holford, in Veterinarian's Vade Mecum*). **Sheep** become giddy, listless, and sometimes die (*Veterinarian* for 1845) Goats and ducks are recorded to suffer. Fifteen grains of the succus injected into the blood-vessels of a full-grown mouse produced, in half an hour,

paralysis, continuing for five hours. Sir Robert Christison found that an ounce of the extract swallowed by **dogs** proved fatal in forty-five minutes ; 90 grains applied to a wound had the same effect in an hour and a half; while 28 grains poisoned in two minutes when injected into the veins (*On Poisons*).

Mr John Gerrard of Market-Deeping records (*Veterinarian*, February 1873) the straying of some **pigs** into an orchard, where they ate growing hemlock. They lay prostrate and unable to rise, no pulse perceptible, the body cold, the eyes amaurotic, and when left alone they lapsed into a comatose hypnotic state. There were no convulsions ; no pain was apparent when they were pricked with a pin. In fifteen hours two died, and two others a few hours later. Examination discovered the blood throughout the body dark-coloured and fluid, the result of the fatal asphyxia ; the intestines distended with gas ; the mucous coat of the stomach, particularly its cardiac portion, was much congested ; similar spots of congestion were observed here and there throughout the intestines. The liver and spleen, as well as the lungs, were distended with dark fluid blood.

Coniïne applied to the eye of a rabbit in amount of one drop caused arrest of respiration, and death in nine minutes ; three drops in the eye of a cat killed it in a minute and a half ; five drops swallowed by small dogs began to operate in thirty seconds, and proved fatal in one minute. Still smaller quantities injected into the veins poisoned with even greater rapidity (*Christison On Poisons*). Conhydrine has similar, but not such powerful, effects.

The fitting **antidotes** are tannic acid, the cautious administration of coffee and other stimulants, ammonia to the nostrils, stimulating enemata, enforced exercise, and artificial respiration.

Medicinal Uses.—Hemlock is given **to relieve muscular spasm** in chorea. It is of no avail in tetanus in horses, nor, as demonstrated by experiment, in strychnine poisoning. **Spasmodic cough** connected with muscular irritability, such as occasionally occurs in epizootic sore throat and bronchitis in horses, is frequently relieved by inhalation of steam, medicated by hemlock, or by swallowing slowly an electuary of

succus conii, glycerin, and ammonia acetate. **Injections** and **suppositaries** are applied in irritable, painful conditions of the urino-genital organs.

DOSES, ETC.—Neither the dried leaves nor the fully-ripened dried fruit are to be depended upon. The fresh leaves and young branches, and preparations promptly obtained from them without heat, are, however, reliable; and the best is the **succus.** Three parts of juice are mixed with one of rectified spirit, allowed to stand for seven days, and then filtered and bottled. This succus has a dark sherry colour, an agreeable odour, and acid reaction; one fluid ounce yields 30 grains of soft extract. Horses and cattle take f℥ij. to f℥iv. sheep and pigs, f℥ss. to f℥j.; dogs, fʒss. to fʒj. Its anodyne and antispasmodic effects are intensified by using it with opium or chloral-hydrate. Coniïne, employed hypodermically by Dr Harley and Mr Mavor, frequently produced irritation and inflammation, which hindered its absorption.

HENBANE.

Henbane or Hyoscyamus leaves. The fresh leaves and flowers, with the branches to which they are attached, of Hyoscyamus niger; also the leaves separated from the branches and flowering tops, and carefully dried. Collected from biennial plants, growing wild or cultivated in Britain, when about two-thirds of the flowers are expanded. B. P. *Nat. Ord.*—Atropaceæ.

Henbane is widely distributed, grows wild in most parts of this country, and is cultivated at Mitcham and Hitchin. The large sinuate usually decurrent yellow-brown leaves, are rough, hairy, and clammy, with a fœtid narcotic odour, and a nauseous bitter taste. The small, round, yellow-grey seeds, sometimes used, resemble the leaves in taste and odour, but are difficult to collect in quantity. The root is white, contains much starch, and resembles the parsnip, for which it has occasionally been mistaken. There are two varieties, an annual and a biennial; the latter, alone recognised by the B. P., is larger, stronger, more branched, clammy, and active. 100 lbs. of the fresh

plant, when dried, weigh 14 lbs., and yield about 4 lbs. of extract.

The active principle **hyoscyamine** ($C_{15}H_{23}NO_3$) in its impure form is an oily liquid, becoming brown on exposure, but it can be slowly crystallised into colourless translucent needles. It is scarcely soluble in water, but readily dissolves in spirit, chloroform, and dilute acids. It is identical with daturine, the active principle of Datura Stramonium, and with duboisine, the active alkaloid of Duboisia myoporoides, but not with atropine, with which however it is isomeric. It is decomposed, and its physiological action neutralised by caustic alkalies.

Actions and Uses.—Hyoscyamus closely **resembles the other atropaceæ**—belladonna and stramonium. Full doses of the drug or the alkaloid stimulate the cerebral centres and paralyse the ends of motor nerves. There are produced dryness of the mouth, general convulsions, paralysis and stupor, alternated with a peculiar form of delirium in which a constant desire for action is accompanied by lassitude, failure of the action of the heart, and of breathing, and death from asphyxia. Locally applied, it diminishes susceptibility of the sensory nerves. It dilates the pupil, although not so certainly and fully as atropine (*Brunton*).

Toxic Effects.—**Horses** receiving an infusion made with three to four ounces of the leaves have dilatation of the pupils, spasmodic movements of the lips, acceleration and subsequently depression of the heart-beats, but no symptoms of acute poisoning. **Dogs** are acted on exactly as by belladonna, **Cats** become dull and drowsy, the mouth and nose dry, the pulse accelerated, the pupils dilated, and the power of walking or springing impaired (*Dr John Harley, Old Vegetable Neurotics*).

Medicinal Uses.—Hyoscyamus is prescribed with cathartics to prevent their griping. It is mainly excreted by the kidneys, and occasionally is used as an anodyne in irritable conditions of the kidneys and bladder. It is prescribed in human medicine in cases of mania and nervous or muscular excitement, and has been used with some success in epilepsy and chorea in dogs. It is occasionally substituted for opium as a topical anodyne.

Doses, etc.—Of the succus and tincture, horses and cattle take f℥j; dogs ♏x. to ♏xl. The extract is six times the strength of the succus or tincture. Hyoscyamine, usually prescribed as a neutral sulphate, is one hundred times more active than the extract, and is sometimes used hypodermically.

IODINE.

Iodum. A non-metallic element, obtained from the ashes of seaweeds, and from mineral iodides and iodates. B. P.

Iodine is present in sea-water, and is thence taken up by sea plants and animals. It is prepared from kelp—the semi-vitrified ashes of sea-weeds—by solution in water, from which sodium chloride, carbonate, and sulphate, with potassium chloride, crystallise out. The dense dark-brown ley, containing the iodine chiefly in combination with sodium and magnesium is decanted off, and mixed with one-eighth of its bulk of sulphuric acid, which precipitates sulphur and more sodium sulphate, and drives off carbonic, sulphurous, and hydrogen sulphide gases. The acid fluid is mixed with manganese dioxide, and transferred to iron retorts, lined with lead, and heated to 140° F., when the iodine volatilises in violet vapour, and condenses in spherical glass vessels in grey lustrous scales, resembling blacklead. By a recent process, the dry seaweed is at once economically subjected to distillation in iron retorts, and yields iodine as well as bromine. From the mother liquors of the Chili nitre mines iodine is now also obtained.

Properties.—Iodine usually occurs in soft friable black or blue-black laminar crystals of a metallic lustre. Its spec. grav. is 4·95. It has an acrid, disagreeable taste, and a pungent, unpleasant odour, resembling that of chlorine or sea-water. Applied to the skin it produces a brown stain, readily removed by alkalies. At the temperature of the atmosphere it slowly evaporates; at 237°F. it melts; at 392°F. it boils, volatilising entirely in distinctive, violet-coloured, irritating, antiseptic vapours, nine times as heavy as air. With water it forms a brownish-yellow solution, containing however, only ·05 per cent. It is dissolved by twelve parts of rectified spirit, and

still more readily by ether, volatile oils, chloroform, carbon disulphide, and also by solution of potassium iodide, and other salts. It readily unites with metals; the iodides of the alkalies closely resemble iodine in their actions; the iodides of the heavy metals exhibit chiefly the properties of the base.

Iodine is easily **distinguished** by its characteristic odour, by the brown stain it leaves on the fingers, by the violet-coloured vapour it evolves when heated, and by the blue colour it forms with a cold solution of starch. This starch test is inapplicable when iodine is in combination, from which, however, it is readily set free by a drop of weak chlorine solution or of diluted nitric acid.

IMPURITIES.—It is liable to intentional adulterations as well as accidental impurities. Blacklead and other fixed substances remain as a residue when a sophisticated specimen is heated. Water, sometimes present to the amount of 15 or 20 per cent., adheres in minute drops to the iodine scales; moistens bibulous paper in which the scales are rolled; and causes them to stick to the sides of a dry glass tube in which they are shaken. The purity tests of the B. P. are as follows:—It sublimes without leaving any residue, and the portion that first comes over does not include any slender colourless prisms (of cyanogen iodide) emitting a pungent odour. 12·7 grains dissolved in an ounce of water containing 15 grains of potassium iodide, require, for complete decoloration, 1000 grain measures of the volumetric solution of sodium hyposulphite.

ACTIONS AND USES.—Large doses, whether in the gaseous fluid or solid state are irritant. Persisted with for long periods it is liable to produce a debilitated condition termed iodism. Medicinal doses are antiseptic, alterative, and stimulant, and exert their effects specially on mucous skin and lymphatic glands. It is almost a specific for diabetes insipidus in horses. Externally it is applied as an antiseptic, stimulant, and counter-irritant. It is employed for the several purposes of an antiseptic, deodorant, and disinfectant.

GENERAL ACTIONS.—Iodine **resembles chlorine and bromine,** especially in its **antiseptic and oxidising** power. One part in 4125 parts of water arrests the action of diastase

and ptyalin; one part in 7817, arrests the action of pepsin; one part in 7000 destroys both bacilli and their spores, (*Wernitz and Koch*). Iodine stains the skin yellow-brown, and strong solutions cause subsequent desquamation of the cuticle, smarting and vessication. When swallowed, it similarly irritates the intestinal mucous membrane. Converted probably into iodides and iodates, it is absorbed into the blood. In the tissues it may be again set free exerting its **antiseptic** and **stimulant** effects. Medicinal doses **diminish thirst, and excessive secretion of urine,** as is very notable in diabetes insipidus in horses. It stimulates the mucous and lymphatic glands, provoking their secretion, and aiding liquefaction and removal of adventitious deposits. It is very doubtful, however, whether it can produce, as has been stated, atrophy of the testicles or udder, or reduce secretion of milk. It combines with lead, mercury, and other metals, hastening their removal from the body. It slightly quickens the pulse. It is **excreted** by the mucous surfaces and glands, notably in the saliva, and the perspiration, while full doses during excretion produce considerable irritation of the excreting channel.

The potassium, sodium, and ammonium **iodides** conjoin the effects of their salt-radicle and base, but are less irritant, less active as gland stimulants, although more prone to affect the kidneys. The iodides of iron, copper, lead, and mercury, mainly exhibit the actions of their powerful bases. In stimulating the skin and mucous surfaces, iodine shews some resemblance to arsenic and sulphur.

Toxic Effects.—Hertwig gave **horses** 40 to 60 grs. of solid iodine twice daily for fourteen days, with the effect of causing slight diarrhœa, with black evacuations and increasing emaciation. Professor Dick repeatedly gave large quantities for several weeks, without observing any other symptom than the total refusal of water. To one horse, he administered for three weeks, doses averaging two drachms per day, and towards the end of the experiment, amounting to two ounces daily. Several ounces have also been given to cattle with the like negative results. In many of these cases the iodine, having been given in the solid form, must have been slowly, perhaps

only partially, dissolved and absorbed, and, during tardy solution, may in great part have been neutralised by contact with starch food.

Dogs receiving two or three drachms of solid iodine, speedily get rid of it by vomiting; but when the œsophagus is tied, such doses cause fatal gastro-enteritis in two to seven days, leaving numerous yellow spots and little ulcers in the stomach, and a peculiar rose tint of the liver (*Cogswell*). Hertwig found that such doses killed every dog to which they were given, inducing sero-sanguineous exudation and hæmaturia.

Iodism, produced by prolonged administration of full doses, is characterised by loss of appetite, an irritable, catarrhal condition of the mucous membrane of the nostrils, eyes, throat, and digestive organs, a vesicular skin eruption, abstinence from water, languor, inaptitude for exertion, and elevation of temperature. But whether in man or the lower animals iodism is exceedingly rare. Where it occurs, it is arrested by withholding the medicine; exhibiting starch, so as to convert any unabsorbed iodine into the innocuous starch iodide, and giving mineral tonics, bitters, and nutritive diet.

MEDICINAL USES.—Iodine is prescribed as an **alterative** and **resolvent** in enlargement of the liver and udder, in chronic rheumatism, especially involving the joints, in hydrothorax, and ascitis, and in persistent cases of psoriasis, in which Professor Williams uses it both externally and internally in the form of liquor arsenii et hydrargyri iodidi (p. 252). Some American practitioners conjoin iodine with carbolic acid in **febrile attacks,** especially when depending upon malaria. **Dry congested** conditions of the **respiratory** mucous **membrane** are sometimes relieved, and secretion of healthy mucus encouraged by inhalation of steam or warm air, medicated with a little iodine tincture. Similar inhalations are also beneficial in checking muco-purulent discharges from the nostrils or sinuses of the head.

Iodine is pre-eminently useful in that variety of **diabetes insipidus** or polyuria, affecting horses, in which 20 or 30 pints of urine are sometimes passed daily, thirst is insatiable, and strength and flesh are rapidly lost. Iodine

given night and morning seldom fails to arrest this disease in two or three days. How it does so, is not satisfactorily explained. It may exert some specific action on those lymphatic glands which are concerned in secondary digestion, or its antiseptic effects may control the excessive production of some injurious enzymes. But neither quinine, iron, nor arsenic, although possessed of notable antiseptic properties, are as effectual as iodine in this form of diabetes. Neither potassium nor iron iodide are as trustworthy as the crude drug. Mr Thomas Dollar, of New Bond Street, London, imforms me that he has experimented with various more correct chemical combinations, but finds in these cases none so reliable as the following formula:—Iodine ʒss, iron sulphate ʒij, powdered gentian ʒiv.,—made into bolus with treacle, syrup, or meal and water. This is repeated once—in bad cases, twice daily. Rarely are more than six doses required to effect a cure.

Externally, iodine is used as a stimulant and resolvent in chronic synovitis, bursal enlargements, muscular pains, strains of tendons, thickening of periosteum, and indurations of the udder and other glands. It is also used as a counter-irritant in sore throat in horses, in circumscribed lung consolidation, especially when occurring in dogs, and in subacute attacks of pleurisy. It is a serviceable stimulant and deodoriser for unhealthy and malignant wounds. Indolent ulcers are sometimes healed by application of a piece of lint, spread with simple cerate, sprinkled with one to five grains of iodine, and covered with a piece of oiled silk or tinfoil. But excess of iodine must be avoided, otherwise corrosive instead of healing effects are produced. Dilute iodine solutions are injected, as stimulating antiseptics and promoters of adhesion, into cysts and abscesses from which serum or pus has been withdrawn. Mixed with wood-tar oil, sulphur, or mercurials, or alternated with them, iodine proves useful in eczema, psoriasis, and lupus, in both the cryptogamic contagious and herpetic non-contagious forms of ringworm; and, like most effectual antiseptics, destroys skin parasites. Iodine is an expensive but effective deodoriser and disinfectant, decomposing noisome organic compounds by uniting chiefly with their hydrogen, and also destroying the lower forms of vegetable and animal life.

DOSES, ETC.—For horses, grs. xx. to ʒi.; for cattle, ʒss. to ʒiss.; for sheep, grs. xv. to grs. xl.; for pigs, grs. x. to grs. xx.; for dogs, grs. iij. to grs. viij. Such doses are repeated once or twice daily; given a couple of hours after eating, in order to diminish the proportion otherwise converted into the mild, insoluble starch iodide; continued for a week or ten days; withheld for a day or two, and, if necessary, again resumed. Larger doses, although they may be given with impunity, do not ensure better curative results.

Iodine is administered in **bolus**; but, handy although this form is for horses and dogs, it is less certain than a good **aqueous solution,** such as is obtained by mixing two parts iodine and one potassium iodide with six or eight of water. The potassium iodide insures perfect solution and full action of the iodine. This concentrated solution is diluted with water as required; the dose is easily ascertained, for the iodide is about half as powerful as the iodine itself. **Tinctures** have nothing to recommend them in preference to the cheaper watery solutions, and, like them, should be made with potassium iodide, otherwise they do not bear dilution.

For **external** purposes, the compound aqueous solution is generally suitable. The weaker solutions are used when gentle stimulation and absorption of iodine are desired. As a counter-irritant, about two parts iodine and one potassium iodide are used, with sixteen of water or fatty matters. For reducing bony enlargements, such an iodine ointment is sometimes mixed in equal proportion with mercury biniodide ointment. For dressing wounds, ten grains each of iodine and potassium iodide to an ounce of water usually suffice. Two parts iodine, one part potassium iodide, four wood-tar oil, and thirty-two of lard or oil, make a serviceable mange dressing. In successfully treating the scaly eruptions of psoriasis, Professor Williams, after a purgative and softening the hard cracks with oil and alkali, uses both internally and externally a triple compound of iodine, arsenic, and mercury (p. 252).

IODOFORM (CHI_3) is a product of the action of iodine on a mixture of alcohol and solution of carbonate of potassium. It has a persistent, disagreeable odour and taste, is scarcely soluble in cold water, but dissolves in ether and chloroform.

It is an **antiseptic** and **deodoriser,** is devoid of local irritant effect, but is **a local anæsthetic;** and in dogs and cats full doses produce narcosis. A few grains dusted over ulcers or malignant growths, deodorise and promote their healing. An etherial injection is used in ozæna and ulcerated sore throat. Pencils made with 50 to 70 per cent. of iodoform, mixed with starch and gum, are used in wooden holders for dressing wounds; while injections and suppositaries made with eucalyptus oil and cacao-butter, are serviceable as deodorisers and local antiseptics in painful conditions of the rectum and urino-genital organs.

IODOL (tetra-iodopyrol ($C_4 I_4 NH$), is a light-brown tasteless crystalline powder, with a faint thymol-like smell, insoluble in water, but dissolved by three parts of alcohol, and also readily in ether and chloroform. It resembles iodoform, but being less irritant, is preferable for internal use. Horses and cattle take grs. xv. to grs. xxv.; dogs, gr. i. to grs. iii. It may be given suspended in glycerin or mucilage.

IODIDE OF SULPHUR is a **stimulant** and **parasiticide.** It is prepared by mixing, in a Wedgwood or glass mortar, four parts iodine with one sublimed sulphur, and gently heating until the mixture liquefies. The red-brown liquid, as it cools, becomes a grey-black crystalline mass, insoluble in water and alcohol, but soluble in glycerin and fats, with eight or ten parts of which it is mixed for ointments or liniments, which are suitable for itching scaly skin complaints, for the cure of ringworm, and, not being poisonous, are used for mangy dogs, without risk or injury from being licked or absorbed.

IPECACUAN.

IPECACUANHA. The dried root of Cephaëlis Ipecacuanha. (B. P.) *Nat Ord.*—Cinchonaceæ.

The Cephaëlis Ipecacuanha is a Brazilian shrub two to three feet high. The root, the only officinal part, is usually collected during the first three months of the year. It occurs in twisted, knotted pieces, two to four inches in length, of the thickness of a quill, and invested with brittle brown bark, marked with un-

equal rings, and greatly more active than the tough, white, internal woody matter. The powder is grey-brown, has an acrid bitter taste, a faint nauseous odour, and communicates its properties to hot water, alcohol, and weak acid solutions. Besides other plant constituents, it contains an odorous volatile oil, the amorphous, red-brown, bitter astringent ipecacuanhic or cephaëlic acid (C_4 H_9 O_7), and, in combination with it, about 1 per cent. of the alkaloid **emetine,** usually occurring in amorphous colourless powder or transparent scales, slightly bitter, soluble in hot water, alcohol, and dilute acids, but not in ether (C_{30} H_{44} O_2 N_8).

Actions and Uses.—Ipecacuan and emetine are topical irritants, are emetics, expectorants, and diaphoretics, and are occasionally used as anti-dysenterics.

Ipecacuanha or emetine, applied locally, **irritate** the skin and mucous membranes. When swallowed by dogs or other carnivora, they irritate the ends of the vagus, and thus **cause vomiting,** and when absorbed into the blood, likewise produce emesis by irritation of the vomiting centre (p. 79). Full doses induce gastro-enteritis, with similar congestion, and œdema of the respiratory mucous membrane and lungs. Professor Rutherford found that 60 grs. ipecacuan powerfully stimulated the liver of dogs; even 3 grs. had an effect on a dog weighing 17 lbs.; no purgation was produced, but an increased amount of mucus was secreted from the small intestine (*Journal of Anatomy and Physiology*, Oct. 1876). Bracy Clark states that 3 ounces kill a horse.

Medicinal Uses.—As an **emetic** for dogs, cats, and pigs, it acts more slowly and gently than zinc or copper sulphates, and is less nauseating than tartar emetic. As an **anti-emetic,** drop doses of the vinum, conjoined with morphine or chlorodyne, are sometimes serviceable in dogs. When given in doses insufficient to cause emesis, or when used in horses or other animals which do not vomit, it **promotes secretion of bronchial mucus,** and hence is serviceable in the dry stages of catarrh and bronchitis. Mr Thomas A. Dollar, of New Bond Street, frequently gives a drachm of powdered ipecacuan with an ounce of medicinal ammonia acetate solution, in ten ounces of water, repeating the dose several times daily. Following

the practice of human medicine, American practitioners prescribe it as an anti-dysenteric, in half-drachm doses, for horses and cattle; and Professor Robertson also recommended it, in conjunction with opium, in these cases.

Doses, etc.—Of the powder, as an emetic, dogs take grs. xv. to grs. xxv.; cats grs. v. to grs. xij.; pigs, grs. xx. to grs. xxx., given in tepid water, either alone or with half a grain to a grain of tartar emetic. Mr Mayhew recommends for the dog ipecacuan, grs. iv.; tartar emetic, gr. $\frac{1}{4}$; with antimonial wine, f℈j. to f℈ij.; dissolved in tepid water, f℥j., and repeated every half-hour until vomiting takes place. Some practitioners use **Dover's powder,** or its pharmaceutical imitation, made by triturating together one part each ipecacuan and opium, and eight parts potassium sulphate. Of this expectorant and diaphoretic, horses and cattle take ℈i. to ℈iij.; sheep, grs. xxx. to ℈i.; dogs, grs. x. to grs. xv.; cats, grs. ii. to grs. v.; repeated several times daily, the patient supplied with plenty of diluents, and kept comfortably clothed, and in an atmosphere of about 60° F. The **wine** is prepared by macerating an ounce of bruised root in a fluid ounce of acetic acid, adding a pint of water, evaporating to dryness, and macerating the residue with a pint of sherry.

Emetine, when inhaled even in minute amount, irritates the mucous membranes of the air-passages, and induces symptoms analogous to hay fever. Two grains swallowed by a dog caused violent vomiting, increased mucous secretion from the respiratory and alimentary membranes, inflammation of the stomach and intestines, stupor, and death in twenty-four hours (*Majendie*). It is eliminated by the mucous membranes and liver, increasing secretion of bile. Large doses lower temperature, relax voluntary muscles, and kill by cardiac paralysis (Dr A. E. D. Ornellas, *Pharmaceutical Journal*, January 1874).

IRON AND ITS MEDICINAL SALTS.

Iron. Ferrum. Ferrum redactum. Pulvis ferri. Fe.

Iron is a lustrous grey metal, tenacious, malleable, ductile; the least fusible of the useful metals, but readily welded at a

white heat, and with a specific gravity of 7·7. It is attracted by the magnet, and becomes itself magnetic. It is widely diffused in rocks and soils, and is present in the structures of plants and animals. Small quantities occur uncombined, probably of meteoric origin. Its chief **ores** are the oxides, comprising magnetic ore and hæmatites; the carbonates or clay iron-stone, and black-band; and the bisulphide or pyrites.

In the blast furnace, in contact with coal, limestone, and sand, or other suitable flux, the ores are smelted or roasted; clay and other impurities are transferred to the fusible slag, while the metal, retaining from 2 to 5 per cent. each of carbon and silicon, is drawn out as **pig or cast-iron.** In the manufacture of **bar or wrought iron,** the cast-iron is exposed to hot air on the refining hearth, to a high temperature in the puddling furnace, and to squeezing under the steam hammer. Most of the carbon, silicon, sulphur, and phosphorus, is thus removed; while, by subsequent pressure under heavy rollers, greater tenacity and more fibrous texture are imparted. The Bessemer process dispenses with the laborious puddling, and secures very similar results by heating cast-iron in large crucibles, and forcing air through the molten mass. **Steel** is made by heating bars of wrought-iron in contact with charcoal, of which it takes up 0·2 to 1·2 per cent.—the former constituting mild steel; the latter, the hardest steel.

Iron forms three compounds with oxygen:—FeO, $Fe_2\,O_3$, and $Fe_3\,O_4$—the last being a compound of the other two. Iron forms two series of salts—the lower proto or ferrous salts, in which it is diatomic and magnetic; and the higher per or ferric salts, in which it is triatomic and non-magnetic.

The ferrous salts are reducing agents, are chiefly grey or green, and in solution give, with hydrochloric acid and sulphuretted hydrogen, negative results; with ammonium hydrosulphide, a black precipitate of hydrated sulphide ($FeS.\,H_2O$); with caustic alkalies, white or grey precipitates of hydrated protoxide, $FeO\,(HO)_2$, rapidly becoming green and then brown; with potassium ferrocyanide, a white precipitate, gradually becoming blue by oxidation ($Fe_4\,3\,Fecy_6$); with potassium ferricyanide, a precipitate dark blue from the first ($Fe_3\,Fe_2\,Cy_{12}$).

The ferric salts are oxidising agents, are mostly brown or

red, and in solution exhibit, with hydrochloric acid, a negative reaction; with sulphuretted hydrogen, give a white precipitate of sulphur; with ammonium hydrosulphide, the black ferrous and ferric sulphides together with sulphur; with caustic alkalies, a brown-red precipitate of ferric hydrate; with potassium ferrocyanide, a deep-blue precipitate of Prussian blue at once goes down; with potassium ferricyanide, no precipitate, but an olive or brown decoloration; with solution of galls, neutral solutions yield a blue-black precipitate—the basis of writing-ink; with potassium sulphocyanide, an intense blood-red colour.

ACTIONS AND USES.—Iron and its salts were the first mineral substances employed in medicine; they have been used for 3000 years; but although anciently and extensively prescribed, a good deal has still to be learned regarding them.

In the economy of nature, iron performs the part of **a carrier of oxygen.** The ferrous oxide being a strong base, has great affinity for all acids. In the soil it combines with carbonic acid, and thus becomes soluble and freely diffused. In contact with air it is further oxidised into ferric oxide, when carbonic acid is given off to be used for plant nutrition, and for solution of plant food. But the unstable ferric oxide, in contact with organic matters, again gives up oxygen forming more carbonic acid, and, reduced to the state of ferrous oxide, is ready again to begin the cycle.

In the bodies of the higher animals, iron occurs **chiefly in the blood.** About 15 grammes, or fully half an ounce, of iron is yielded from the blood of a horse or ox of about 1000 lbs. weight. In the hæmoglobin and oxyhæmoglobin, the iron performs much the same functions as it does in the ferrous and ferric oxides in the soils. In the lungs, hæmoglobin takes up oxygen, and becomes oxyhæmoglobin, which readily parts with oxygen as it circulates through the capillary vessels. Thus maintaining the healthy activity of these blood constituents, iron is said to act as a **hæmatinic or blood tonic.** Its curative effects are specially manifested in anæmia and chlorosis, in which the number of red corpuscles and amount of hæmoglobin are seriously reduced, sometimes to the amount of

one-fifth of their normal proportion, impairing tissue oxidation and functional activity. Clinical observation testifies that full doses of iron restore the pallid soft textures to their normal colour and firmness, and improve general health. These curative results have hitherto been supposed to depend upon the medicine being absorbed, and directly furnishing iron to the hæmoglobin, restoring its deficiency, and aiding the formation of red blood corpuscles from leucocytes.

The recent investigations of Professor Bunge, of Basil, discredit this view. Dr Stockman, Assistant to the Professor of Materia Medica, University of Edinburgh, in an abstract of these researches, published in Part IV. of the *Journal of Comparative Pathology and Therapeutics*, points out—(1) That the normal waste of iron and hæmoglobin in the blood is proved to be small. (2) This waste is more than compensated by the ordinary food which contains iron in an organic form, probably as hæmatogen. (3) But although this form of iron present in food is soluble in alkaline solutions, and is readily absorbed from the intestines, ordinary iron salts, contrary to the views generally held, **do not appear to be absorbed,** and hence cannot, as has been hitherto supposed, directly restore iron to the blood. Professor Bunge and Dr Stockman believe that the primary factor in the production of anæmia and chlorosis "is great poverty of the gastric juice, with attendant dyspepsia and formation of alkaline sulphides. These alkaline sulphides are capable of decomposing the absorbable albuminous iron compounds, and thereby render them, like ordinary iron salts, incapable of absorption. Hence the deficiency of hæmoglobin."

Iron preparations are believed to **cure anæmia by removing the dyspepsia** which interferes with the assimilation of the soluble iron in the food. They are attacked by the excess of alkaline sulphides. "In favour of this view," continues Dr Stockman, "is the fact that such enormous doses of iron require to be given to cure a case of chlorosis—small doses being of no value. In two or three days, more iron may be given than is present in the whole body; secondly, good hygienic measures and attention to diet frequently cure chlorosis without iron; thirdly, in a healthy subject, con-

tinued administration of iron does not raise the red corpuscles and hæmoglobin above the normal standard. In all forms of anæmia, which have their origin outside the alimentary canal, iron must therefore be powerless."

Neither ferrous nor ferric salts dissolve or pass through the epidermis. Both coagulate albumin, and exert astringent effects on mucous and denuded skin surfaces, and also coagulate blood. Professor Bunge is very confident that iron salts, like those of manganese, howsoever administered, are **not absorbed** from the alimentary canal. They certainly do not directly increase the percentage of iron in the blood, nor the amount excreted by the urine, or in the secretions poured into the intestines. Soluble iron salts, which do not coagulate albumin, when **injected** into the circulation **produce metallic poisoning,** characterised by muscular and nervous depression, cardiac weakness, and renal inflammation. But when iron salts are swallowed no such effects are produced, which would certainly be the case if they were freely absorbed. Professor Bunge further states "that all the iron salts—inorganic, organic, and albuminates—become in the stomach either ferrous or ferric chlorides. In the intestine the sodium carbonate, which is always present, turns the ferric chloride into ferric oxide, which remains dissolved in the organic matters of the alimentary canal. On the other hand, the ferrous chloride is transformed into ferrous carbonate, which also remains dissolved in the carbonic acid and organic matters. Both are finally converted into sulphide by the alkaline sulphides formed during digestion, and are so excreted in the fæces."

The numerous salts of iron possess very much the same kind of action, but differ considerably in the degree of their activity. The more soluble ferric salts are most antiseptic, astringent, and corrosive. In the earlier stages of convalescence, where the stomach is irritable, in young patients, and especially in dogs, ferrous carbonate or iodide in the saccharated form is usually better borne than the ferric chloride or even the ferrous sulphate. But in order to realise the full tonic effects of iron, it is specially essential that the bowels be maintained in a natural state, and an occasional laxative should be given to clear away the excess of alkaline sulphides which character-

ise most cases of anæmia. Where prompt astringent effects are to be produced, full doses of the chloride or other soluble ferric salts are given.

The Pharmacopœias enumerate nearly forty salts of iron, but those chiefly used in veterinary practice, and hence demanding special notice, are the saccharated carbonate, ferrous sulphate, and iodide, with the ferric oxide and chloride.

Metallic iron, as filings or pulvis ferri, is occasionally given in poisoning with salts of mercury and copper. **Iron arsenite** has been prescribed in squamous and herpetic skin diseases, in about the same doses as arsenic, and is also applied externally. **Citrate of iron and quinine,** conjoining the tonic properties of its components, is occasionally used for dogs, in doses of four to ten grains (p. 345). Dyalysed iron and amorphous quinine have been conjoined. The **phosphate** ($Fe_3 P_2 O_8$), recommended as being the form in which iron occurs in the blood, is sometimes prescribed in strumous diseases of the bones, in diabetes, and in nervous disorders. It is occasionally given to delicate dogs and thriftless foals along with other phosphates, as in the form of Parrishs' Chemical Food, and in nervous depression with quinine and strychnine in the preparation known as Easton's Syrup.

IRON CARBONATE. Ferri Carbonas. Ferrous Carbonate. $Fe CO_3$.
SACCHARATED CARBONATE OF IRON. Ferri Carbonas Saccharata.

The ferrous carbonate occurs in clay iron ore, and in many mineral waters. It is prepared by mixing solutions of iron sulphate and ammonium carbonate. It is greyish-green, has a chalybeate inky taste, and dissolves with brisk effervescence in hydrochloric acid. Exposed to the air, it rapidly absorbs oxygen, gives off carbonic anhydride, and becomes converted into ferric oxyhydrate—a change constantly taking place along the banks of chalybeate streams.

The **saccharated carbonate** is greatly more stable. It is made by rubbing the freshly-prepared carbonate with sugar in a porcelain mortar. It occurs in small coherent grey lumps, has a sweet, feebly chalybeate taste, and should contain at least 37 per cent. of carbonate. It is readily soluble; is a

mild chalybeate; especially convenient in canine practice, and administered for the same purposes as the sulphate in three times the doses.

IRON SULPHATE. Ferri Sulphas. Ferrous Sulphate. Green Vitriol. Copperas. $Fe\ SO_4.\ 7H_2O$.

Iron sulphate may be got by dissolving iron in sulphuric acid; it is the by-product in the making of hydrogen sulphide; but the large supplies required in the arts and in medicine are chiefly obtained from clay shale or alum schist, which contain iron pyrites or bisulphide ($Fe\ S_2$). Such schists yield both iron sulphate and alums (p. 210). They are broken into fragments: unless containing sufficient bituminous matter, they are heaped in alternate layers with coal and slowly roasted. The sulphur is thus converted into SO_3 and combines with alumina. The heaps remain for several months exposed to the air, and are frequently wetted, when the $Fe\ S$ is gradually changed into $Fe\ O\ SO_3$ or $Fe\ SO_4$. The heap is lixiviated with water, and the solution evaporated, when the iron sulphate crystallises out, leaving in solution the more soluble aluminum sulphate.

Iron sulphate occurs in bluish-green, oblique rhombic prisms, which, on exposure to the air, gradually oxidise, becoming opaque, and covered with a brown coating of the normal and basic ferric sulphates; an excess of sulphuric acid retards this oxidation. It has an inky, styptic taste; is insoluble in rectified spirit, but soluble in one-third its weight of boiling water and twice its weight of cold water. Heated, it fuses, readily parts with six molecules of water of crystallisation, retaining, however, the seventh more tenaciously. Its distinguishing tests are those of other ferrous salts (p. 418).

ACTIONS AND USES.—When swallowed it is a hæmatinic tonic, and astringent, and in large doses irritant. Applied externally it is astringent, styptic, and antispetic. Comparing ferrous sulphate with other salts of iron it is regarded as twice as active as the oxides and carbonates; but is not so astringent, corrosive, or irritant as the ferric chloride or nitrate. As an antiseptic it is not so powerful as the ferric chloride, but has about the same power as the sulphates of alumina and zinc.

MEDICINAL USES.—Iron sulphate is administered to all veterinary patients in **anæmia,** and especially when it is connected with dyspepsia. It improves the appetite, diminishes exhausting discharges, and abates glandular enlargements. It is specially beneficial in anæmia occurring in young horses, cattle, or sheep kept throughout the late autumn or winter on grass that has lost its nutritive value, or in young stock that have been reduced by restriction to indigestible poor straw fodder. Along with concentrated good food, the iron salt in many such cases is advantageously conjoined or alternated with bitter tonics, nux vomica, acids, and occasionally with arsenic.

In conjunction with nutritive and oleaginous diet, iron is often useful in the earlier stages of tuberculosis and of farcy. It is said to abate nasal gleet and leucorrhœa. In **atonic torpidity** of the bowels, and for **removing worms** in horses, a drachm of the sulphate is often given with one or two drachms of aloes. Other practitioners give full doses of the ferrous sulphate to destroy intestinal worms, and impart to the mucous membrane a healthier condition unfavourable to the development of parasites. Combined with iodine, it arrests that form of **diabetes insipidus** common in horses. It is one of the remedies given to check the earlier progress of liver-rot in sheep. Chorea and epilepsy, especially when connected, as they often are, with anæmia, are benefited by iron. In septicæmia, pyæmia, and other forms of **blood-poisoning,** the sulphate or other soluble salt is used. In **hæmorrhagic cases,** as in purpura, it is prescribed with a mineral acid, and alternated with quinine. After the bowels are freely opened, it aids recovery of cattle and sheep from red water.

In **convalescence** from debilitating disorders, it is regarded as a valuable hæmatinic. In the several forms of influenza in horses it is largely used. During recovery from influenza and bronchitis, Professor Robertson was wont to give iron sulphate and nux vomica, of each half a drachm, with about four drachms of powdered gentian, in bolus. In irritability, chronic catarrh, or hæmorrhagic conditions of the bladder, such as accompany or follow epizootic disorders in horses, it has been prescribed with sulphuric acid and alternated with salicylic acid. A like prescription or a course of iron and

quinine is advised in convalescence from nephritis. Although itself devoid of purgative effect, iron sulphate is stated to increase the activity of most cathartics with which it is combined. The sulphate is not much used for external purposes.

Doses, etc.—Horses take ʒss. to ʒij.; cattle ʒi. to ʒiv.; sheep grs. x. to grs. xxx.; pigs grs. v. to grs. xx.; dogs grs. ij. to grs. x. The smaller doses are given as hæmatinics and tonics; the larger for astringent purposes. The drug is administered in bolus, solution in water gruel or ale, or mixed with soft food, and repeated twice or thrice daily. As a tonic for horses and cattle one to two drachms iron sulphate, and half an ounce each of gentian and ginger are made into bolus or dissolved in a pint of ale or gruel. Such proportions make three or four doses for sheep and eight or ten for dogs. To obviate gastric irritation or constipation, and maintain the continued good effects of iron tonics, after being used for a week or ten days, they should for several days be withheld or replaced by other tonics. Confinement of the bowels, and the dark colour and sulphurous odour communicated to the dejections are abated by appropriate diet, and an occasional laxative.

Iron Iodide. Ferri Iodidum. Ferrous Iodide. $Fe\,I_2.4\,Aq.$

When iodine, iron wire, and distilled water are gradually heated together, combination occurs; and the solution, filtered and evaporated, yields tabular green crystals, which are inodorous, have a styptic metallic taste, and are soluble in about their own weight of water and alcohol. When heated, they give off violet-coloured fumes of iodine; and exposed to the air, deliquesce and acquire a red-brown colour. This oxidation is retarded by keeping the solution secluded from light, in well-stoppered bottles, in contact with fresh iron wire; by boiling the freshly-prepared solution in syrup; or by casting the iodide into small plates or cylinders, and at once dipping it in pure stearin, which can be scraped off when the salt is required for use.

Actions, Uses, and Doses.—It is hæmatinic, tonic, alter-

ative, and astringent. Poisonous doses are irritant, and produce the effects of iron rather than of iodine. Thus, Dr Cogswell found that three drachms caused in dogs vomiting and purging: while one drachm in concentrated solution killed a rabbit in three hours and a half, with the symptoms and post-mortem appearances of poisoning with other soluble salts of iron.

Besides being used for the same hæmatinic purposes as the sulphate, it is given to promote absorption of glandular enlargements, especially in young and weakly animals; it is serviceable in scrofulous swellings of the joints; and was commended by Mr Morton for its efficacy in polyuria and nasal gleet in horses. The doses are the same as those of the sulphate. It is used in bolus, saccharated powder, and syrup.

IRON SESQUI-OXIDE. Ferric Oxide. Ferrugo. Rust of Iron. Fe_2O_3. H_2O.

IRON PEROXIDE MOIST. Ferri peroxidum humidum. Moist ferric oxide. Fe_2O_3. (H_2O), with about 86 per cent. of uncombined water.

Red or ferric oxide is found native in the several varieties of hæmatite, ochre, red chalk, and specular ore. The hydrate is prepared by boiling a solution of ferrous sulphate with a few drops of nitric acid, and as much sulphuric acid as it already contains; decomposing this ferric sulphate by an alkali,—the B. P. orders solution of soda,—and washing the soft red-brown magma thrown down. This moist ferric oxide, freshly prepared, is the **best antidote for arsenic.** It mechanically entangles the particles of the poison, and further converts it into an insoluble iron arsenite. In human patients, doses of a table-spoonful are given every five or ten minutes. Sir Douglas Maclagan states that twelve parts of this hydrate are sufficient to neutralise one part of arsenious acid. Another antidote is the Ferri oxidum hydratum cum magnesia, made by mixing a solution of magnesia with a solution of iron tersulphate (U. S. P.)

IRON PER- OR SESQUI-CHLORIDE. Ferri perchloridum. Ferric Chloride. $Fe_2 Cl_6$.

Iron perchloride is prepared by heating the metal in excess of chlorine gas, or dissolving it in hydrochloric acid, with a little nitric acid added to insure production of the higher chloride. The green crystals, having a great affinity for water, quickly melt. The strong watery solution—the **Liquor Ferri Perchloridi Fortior**—is orange-brown, odourless, inky-tasted, has a specific gravity of 1·42, and is miscible in all proportions with water and alcohol. Diluted with three measures of water, it constitutes the **Medicinal Solution,** which, for ordinary veterinary purposes, is as effectual and cheaper than the **Tinctura Ferri Perchloridi,** known as tincture of steel, or steel drops, and made by mixing one measure each of strong watery solution and rectified spirit with two of distilled water. This tincture has a red-brown colour, an ethereal odour, an acid chalybeate taste.

ACTIONS AND USES.—Iron perchloride, whether in watery or alcoholic solution, is one of the most soluble, irritant, and corrosive preparations of iron. It is prescribed as a hæmatinic tonic, antiseptic, astringent, and styptic; and used topically as an antiseptic, astringent, and caustic.

MEDICINAL USES.—The solutions of the chloride are serviceable in most of the cases in which the sulphate has been recommended. They conjoin, with general tonic effects, marked astringent action. They are prescribed in **atonic dyspepsia,** and for the removal of intestinal worms. In **relaxed and diphtheritic sore throats,** which accompany and follow catarrhal fever in horses, half drachm doses, with equal quantity of glycerin and six or eight ounces of water, are given every two hours, administered slowly, so as to act as a gargle, or applied with an atomiser. They are used in anæmia and the several conditions connected with it. Professor Williams states, "When debility and anæmia are associated symptoms, I have found the salts of iron, more especially the tincture of the terchloride, to have a marked effect in promoting absorption of inflammatory products, fluid and solid. I have a far higher opinion of the effects of iron

salts than of iodine or of iodide of potassium. The practitioner, however, is at liberty to combine the iodine with the iron" (*Principles and Practice of Medicine*). In **influenza** and **purpura** in horses, it improves the appetite, and is credited with tonic effects both on the blood and arterioles. In **hæmorrhagic cases** it is sometimes prescribed with turpentine; in purpura, with quinine; Professor Robertson was wont to treat purpura with iron chloride and sulphuric acid, with occasional doses of potassium chlorate. In **rheumatism,** especially in weakly subjects, it is useful, and may be alternated with salicylic acid. It is administered as an astringent and stimulant of the urino-genital mucous membranes—the tincture, on account of its greater tendency to be excreted by the kidneys, being in such cases preferable to the watery solution. After the bowels are opened, it is serviceable in red-water in cattle.

It is particularly suitable in most cases of **distemper** and **kennel lameness** in dogs; and, with or without arsenic, benefits most attacks of chorea, and many of epilepsy. In dogs, as in other animals, it promotes recovery from most exhausting diseases.

Externally, it is used as an **antiseptic** and **astringent.** It coagulates albumin, and hence is a valuable **styptic.** Diluted with six or eight parts of water, the medicinal solutions are injected into the uterus in cases of post-partum hæmorrhage. Two drachms to a pint of water, injected into the rectum, destroys and brings away ascarides. Actinomycosis, after scraping, is sometimes dressed with the strong liquor, and subsequently with weaker solutions.

Although not so effectual an **antiseptic** as corrosive sublimate, it readily yields part of its chlorine, and arrests the action of ferments. A solution of 5 per cent. in water in two days retarded the growth of anthrax bacilli, and in six days effectually destroyed both bacilli and their spores—which was effected, however, in two days by corrosive sublimate (*Koch*).

Doses, etc.—Of the medicinal liquor and tincture horses and cattle take f℥ss. to f℥j.; sheep, ♏xx. to ♏xxx.; pigs, ♏x. to ♏xx.; dogs, ♏j. to ♏x. The smaller doses suffice for hæmatinic or tonic purposes; are repeated two or three times

daily; are diluted with at least ten parts of water, ale, or gruel; are sometimes conjoined with mineral acids, gentian, and other bitters, or with alcohol or ethers. They are incompatible with ammonia, alkalies, or their carbonates, and with tannin-containing substances. The larger doses mentioned are given when powerful astringent effects are required.

JABORANDI.

PILOCARPI FOLIOLA. The dried leaflets of Pilocarpus pennatifolius (Lemaire). B. P. *Nat. Ord.*—Rutaceæ.

The shrubs yielding jaborandi are natives of Brazil. The leaves and bark have a slightly aromatic odour, and a bitter, pungent taste, and produce, when chewed, a tingling sensation, and increased secretion of saliva. The leaflets are about four inches long, and contain an acrid resin; an essential oil, consisting in part of a dextrogyrate terpene ($C_{10}\ H_{16}$); and an amorphous liquid alkaloid, **pilocarpine** ($C_{11}\ H_{16}\ N_2\ O_2$), which is soluble in alcohol, ether, chloroform, ammonia, and dilute acids, and forms crystallisable salts, the hydrochlorate and nitrate being chiefly used. Another alkaloid, **jaborine,** has been described.

ACTIONS AND USES.—Pilocarpine and jaborandi leaves stimulate glandular secretion and paralyse involuntary muscular fibres. They produce enormous flow of saliva, and, in human patients, profuse skin secretion; in all animals, they promote intestinal peristalsis. Along with physostigmine, they have been used to empty the bowels of horses, and are also myotics. Jaborine resembles atropine, and is antagonistic to pilocarpine.

GENERAL ACTIONS.—Pilocarpine **stimulates the peripheral terminations of efferent nerves going to glands,** and hence **provokes profuse secretion of saliva** from the sub-maxillary, sub-lingual, and parotid glands. It also stimulates the salivary nerve-centres. In man, it stimulates in like manner the sweat glands, one or two pounds of fluid being poured out within two or thee hours. But no such profuse skin secretion occurs either in horses or dogs. It **increases secretion** of tears, of mucus from the glands of the respiratory and digestive tracts,

of urine, occasionally also of milk, but does not increase secretion of bile. It first **stimulates and then paralyses** the efferent nerves, going to structures composed of **involuntary muscular fibre.** It hence contracts the pupil, and causes spasm of accommodation. It **increases intestinal peristalsis,** as has recently been shewn, by its intensifying the effects of physostigmine. It slows the pulse and lowers blood-pressure. It contracts the bladder, uterus, and spleen. Large doses lessen, but do not quite destroy, irritability of voluntary muscles and motor nerves. Poisonous doses cause dyspnœa and convulsions, with **death usually from cardiac failure.** The most effectual **antidote** is atropine, which antagonises the fatal collapse ; nausea and vomiting are relieved by morphine.

Mr I. Print of Clapham, gave **horses** two to four drachms of the leaves infused in hot water, and in fifteen to twenty minutes observed profuse salivation, continuing for three hours but without notable diaphoresis, altered circulation, or temperature. Carriage horses, to which I gave two to four drachms, in fifteen minutes had saliva abundantly outpoured, and the discharge continued for two to three hours; very slight diaphoresis occurred for twenty minutes; no change was noticeable in the pulse, temperature, or quantity of urine excreted. Mr William Dollar injected hypodermically $1\frac{1}{2}$ grains pilocarpine in ten parts water into the shoulder of an aged horse, $15\frac{1}{4}$ hands; in six minutes marked salivation set in, the saliva pouring out of the mouth; the secretion from the buccal glands also appeared to be augmented; these effects continued for fully an hour and a half; the pulse was lowered in force, and was slowed to the amount of two to three beats; the skin, previously dry, became moist, but there was no distinct sweating.

Professor Fred. Smith, of the Army Veterinary School, Aldershot, recently experimented with pilocarpine, and reports that in horses, " in about ten minutes after a subcutaneous injection, a profuse flow of saliva occurs, the animal keeps champing his jaws constantly, whilst saliva flows from the mouth sometimes in quite a stream. There is no attempt at sweating; the sweat glands of the horse are perfectly insensible to the action of pilocarpine. The involuntary muscle of the

intestinal canal is stimulated, and the rectum is repeatedly emptied. . . . In one case I observed a gulping sound in the throat, resembling the effect produced by aconite. The effect on the pulse is very difficult to determine. The constant movement of the jaws induced by the flow of saliva precludes the pulse being taken there. I noticed in one case that a horse which had naturally a very intermittent pulse, after receiving three grains of pilocarpine, the pulse became regular but not increased in frequency" (*The Veterinary Journal*, June 1888).

Half a grain of pilocarpine caused in **dogs** profuse salivation continuing for six hours with increased action of the bowels and kidneys. Half a drachm to a drachm of the leaves infused in water produced in English terriers 15 to 20 lbs. weight, abundant salivation but no notable diaphoresis.

MEDICINAL USES.—The prompt removal of fluid by the skin and saliva has suggested in human patients the use of pilocarpine for absorption of pleuritic and other effusions, and for the removal from the body of posions, urea, and other products of tissue waste. It has accordingly been used in rheumatism, in chronic eczema, and prurigo, and vicariously to relieve the kidneys when affected by disease. Its paresis of involuntary muscular fibre has led Mr Fred. Smith to use it with physostigmine in **overcoming spasm of the bowels** (pp. 282, 283). It has also been substituted for physostigmine as a **myotic**, diminishes intra-ocular pressure, and hence is useful in glaucoma.

DOSES, ETC.—Of the fresh leaves horses or cattle take ʒij. to ʒiv.; sheep, pigs, or dogs, ʒss. to ʒi., given as an infusion. Pilocarpine nitrate or hydrochlorate is prescribed usually hypodermically, to horses and cattle in doses of gr. i. to grs. ij.; to dogs, gr. $\frac{1}{10}$ to gr. $\frac{1}{2}$.

JALAP.

Jalapa. The dried tubercules of Ipomœa Purga (Hayne), (Exogonium Purga Bentham). B. P. *Nat. Ord.* Convolvulaceæ.

Jalap derives its name from Xalapa, or Jalapa, a town in Mexico, whence it was first obtained. The hardy climbers

yielding it, grow on the Andes, 6000 feet above sea level; are cultivated in Southern India; and in sheltered spots in this country, produce their salver-shaped crimson or light-red flowers. The perennial root-stock throws off underground shoots, which at intervals send down roots gradually thickening, becoming irregularly oblong or ovoid, ranging in size from a walnut to an orange, invested with a thin brown furrowed wrinkled cuticle, and presenting within a dirty yellow colour with dark-brown concentric circles. The larger roots or tubercules, are divided into halves or quarters, or gashed to facilitate drying. They are tough and difficult to reduce to powder, which has a pale-brown colour, a faint disagreeable odour, and a taste at first sweet and mawkish, but afterwards acrid and nauseous. Water dissolves the sugar and mucilage without the cathartic resinous principles, which are, however, readily soluble in rectified spirit.

Along with 20 per cent. of starch and cellulose, similar proportions of uncrystallisable sugar, and of watery extractive, with 10 of gum, jalap contains 15 per cent. of a **resin** consisting chiefly of the glucoside convolvulin, which differs from the jalapin of scammony in being insoluble in ether.

Actions and Uses.—Jalap is a hydragogue cathartic, a vermifuge and cholagogue. The ordinary jalap closely resembles the larger rooted male jalap or orizaba root, the smaller paler tubercules of the Tampico root, the dried root of Convolvulus Scammonia, and the root of Bryonia alba and B. dioica, as well as the Kaladana seeds used roasted as a purgative by the nations of Hindostan. It is more active than senna, the leaves of Cassia acutifolia, but less powerful and irritant than gamboge, podophyllum, elaterium, or colocynth.

Jalap has very slight cathartic action either on horses or cattle. Two or three ounces given to the horse has slight effect on the bowels, but increases the activity of the kidneys (*Moiroud*). White reports administering half a pound to horses without causing purgation. I have repeatedly given cows four ounces without perceptible effect. For **dogs and pigs** it is, however, a **good purgative**, although full doses occasionally produce also nausea and sometimes vomiting. It is prescribed for most purgative purposes, acts tolerably speedily, and certainly,

produces full watery discharges, and is specially effective when given with a grain or two of calomel. Professors Rutherford and Vignal, experimenting upon dogs, found that jalap stimulates secretion of bile, and still more notably secretion from the intestinal glands (*Journal of Anatomy and Physiology*, 1876).

Doses, etc.—Dogs take ʒi. to ʒij.; cats, ʒss.; pigs, ʒi. to ʒiv. It is best given in combination with calomel. Dogs, if fasted for six hours, are effectively physicked in two or three hours by ʒss. to ʒi. of jalap, with two or three grains of calomel, made into bolus with any convenient excipient.

JUNIPER TOPS, FRUIT, AND OIL.

Juniperi Cacumina, Fructus et Oleum. Dried tops and fruit of the J. communis. Oil distilled from the unripe fruit. *Nat. Ord.*—Coniferæ.

The several varieties of the common juniper are shrubby evergreen trees, growing in most temperate countries. The leaves are dark green, linear, and arranged three in a whorl. The fruit or berries are bluish-purple furrowed, of the size and appearance of currants; take two seasons to come to maturity; have an aromatic, terebinthinate odour, and a warm, sweet taste, followed by bitterness. For flavouring gin, about 2 lbs. are added to the 100 gallons of spirit. They contain 20 to 30 per cent. of glucose, with resin organic acids and juniperin—a yellow powder, soluble in alcohol, ether, and hot water; but their activity depends on 2 per cent. of two volatile oils, one of which is polymeric with terpene ($C_{10}\ H_{16}$).

From the wood of the Juniperus oxycedrus, and occasionally from that of the communis, the brown empyreumatic **oil of cade** is got by dry distillation; is used in France and other Continental countries for most of the purposes of oil of tar, and is recommended in scaly skin diseases.

Actions and Uses.—The tops, fruit, and oil of juniper are mildly stimulant, stomachic, carminative, and diuretic.

They **resemble** the turpentines, the tops and oil of Juniperus sabina, and the twigs and oil of thuja, or arbor vitæ.

Two ounces of the berries given to horses and cattle have little notable effect; but three or four ounces induce diuresis.

The fruit and oil are occasionally given as **stomachics** and **carminatives** in indigestion and flatulence; are stated to diminish the evil effects of bad fodder and marshy pastures; and to aid alike the prevention and cure of sheep-rot.

DOSES, ETC.—Of the fruit as a stomachic, horses and cattle take ℥i. to ℥iij.; sheep, ʒij. to ʒiv.; dogs, grs. xx. to grs. xl.; repeated several times a day, and usually given coarsely powdered and mixed with fodder. They are readily eaten by most animals, especially by sheep. A decoction, made either from the fruit or tops, is occasionally prescribed, and also used as an external stimulant. As a diuretic, the oil is the best form. Horses and cattle take ʒi. to ʒij.; dogs, ♏ v to ♏ x., which may be repeated at intervals of three hours till diuresis is induced.

KAMALA.

A powder which consists of the minute glands and hairs obtained from the surface of the fruits of Mallotus philippinensis or Rottlera tinctoria (B. P.) *Nat. Ord.*—Euphorbiaceæ.

The glanular brick-red resinous powder, mixed with minute thick-walled stellate hairs, which constitute Kamala, are obtained from the capsules of an evergreen shrub or small tree indigenous to Australia, India, and Abyssinia. It yields an active yellow crystalline substance—rottlerin.

ACTIONS AND USES.—It is a drastic purgative and vermicide, nearly as effectual for the destruction of tape-worm, but rather more severe than areca-nut and male shield fern. The dose for a dog is ʒss. to ʒi., administered in thick gruel or treacle.

KERATIN.

A mucilaginous solution, which, when dry, is a yellow gum-like substance, insoluble in gastric juice, but soluble in the intestinal juices, and used for coating boluses or pills which are required to pass through the stomach without acting upon it, and to undergo solution in the intestines.

Keratin is prepared from horn-turnings by digesting them with artificial gastric juice, so long as they yield any soluble

matters. They are then digested for some weeks in solution of ammonia or glacial acetic acid, which gradually dissolves them. The ammonia solution is generally used, but the acetic acid solution is suitable for those drugs which might be decomposed by ammonia. The medicines, made into bolus in the usual way, are generally thinly-covered with cacoa-butter, and then coated twice with keratin. This method of administration is useful—

I. For drugs which irritate the gastric mucous membrane—such as anthelmintics, arsenic, creasote, salicylic acid, phosphorus, and the more soluble iron salts.

II. For such substances as impair digestion in the stomach by precipitating pepsin and peptones—*e.g.*, tannic acid, alum, lead acetate, silver nitrate, corrosive sublimate, etc.

III. For such substances as are rendered inert by the gastric juice, or are undesirably acted upon by it—*e.g.*, alkalies, soaps, bile, silver nitrate, iodides of iron and mercury, etc.

IV. For medicines which it is desired to introduce into the duodenum in as concentrated a form as possible—*e.g.*, kousso, male shield fern extract, santonin, bile, alkalies, and silver nitrate, lead acetate, or tannin, when their local action is sought to be applied in ulceration or hæmorrhage of the intestines (*Dr Lauder Brunton, Pharmacology*).

KOUSSO.

Kosso. Cusso. Brayera. The dried pannicles, chiefly of the female flowers, of Hagenia abyssinica, or Brayera anthelmintica (B. P.) *Nat. Ord.*—Roseæ.

Kousso consists of bundles, rolls, or complex clusters of pannicles of small reddish-brown flowers, yielded by an aborescent Abyssinian rosacea. Its active principle is kossin—an acid crystalline substance, with a bitter acrid taste, insoluble in water, but soluble in alcohol. It besides contains a bitter resin, tannic acid, and a volatile oil.

Actions and Uses.—Owing, apparently, to its acrid taste, it nauseates dogs and cats, causes considerable catharsis, kills intestinal worms, and is used as a remedy for tape-worm.

Dogs take ʒj. to ʒiv., administered in honey or treacle, the taste veiled by a little peppermint water, and followed in a few hours by a dose of castor-oil. Kossin is occasionally given to dogs in grs. x. to grs. xx.

LANOLIN.

A cholesterin fat obtained from sheeps' wool.

Sheeps' wool, steeped and boiled with water and exposed to pressure, yields about 11 per cent. of lanolin. It has a firmer consistence than most fats, rapidly takes up 100 parts of water, is of a yellow-brown colour, and has a faint odour. The glycerin present in most fats is replaced by cholesterin, and hence lanolin does not yield soap when boiled with an alkali.

Actions and Uses.—It is stable and unirritating, and accordingly makes a good permanent protecting lubricant. It is used as a basis for ointments and liniments ; mixes readily with other fats and oils ; is often conjoined with starch, bismuth, or zinc-oxide ; and on account of its bland properties has been used in cases of weeping eczema in dogs. It was introduced with the recommendation that it possessed specially penetrating and absorbent powers ; but Dr Jamieson, of Edinburgh, has shewn that in this particular it does not materially differ from lard (*The Edinburgh Medical Journal*, August, 1887).

LEAD AND ITS MEDICINAL SALTS.

Lead. Plumbum. Pb.

Lead is chiefly obtained by roasting galena, the sulphide (Pb S). It has a blue-grey colour, and a peculiar odour when rubbed ; is soft and fusible, melting at 617° F. ; is readily cut and rolled into sheets or pipes. It has the specific gravity of 11·4. Exposed to air it oxidises, loses its metallic lustre, and becomes dull and opaque. In contact with air and water, a soluble basic carbonate is gradually formed, and water thus contaminated is dangerous. Lead is divalent or diad.

Actions and Uses.—Metallic lead is devoid of medicinal or poisonous action. Shot—an alloy of lead, with 2 per cent. of arsenic—is occasionally used by the lower order of dealers, temporarily and mechanically, to relieve the distressed breathing of broken-winded horses. Four ounces of metallic lead were given to a dog at the Veterinary School of Lyons without effect. The metal introduced into the animal body, in frequently repeated although small quantity, is apt, however, to become oxidised, dissolved, and cause poisoning. Painters, plumbers, and other persons working with lead, frequently suffer from lead-poisoning, and such poisoning is also occasionally produced in the domestic animals.

The soluble salts, such as the nitrate and acetate, **unite with albumin.** They do not irritate either the skin or mucous membranes, but are astringent and sedative. They have a sweet rather than a corrosive taste. When swallowed, they exert on the intestines powerful astringent effects, and also cause contraction of arterioles, with elevation of blood-pressure and slowing of the heart action. Lead salts are **absorbed** from the stomach chiefly as albuminates. They **irritate and then paralyse voluntary and involuntary muscles, and also the central nervous system.** This two-fold action is illustrated by their causing vomiting in dogs and cats, and in all animals cramp of the intestinal and other muscles; while fuller or more continued doses subsequently develop paresis. On the nervous system they produce choreic and convulsive movements, succeeded by paralysis. These effects are believed to result from the actual presence of lead in the nervous textures. The primary irritant and secondary paralysant effects, notable in human patients, also occur in horses and cattle. The muscular weakness and paralysis are well-marked in frogs and rabbits, are less pronounced in cats, and are absent in dogs. Elimination is effected partially in the urine, mainly in the intestinal mucus (*Brunton*).

Lead poisoning or plumbism occurs in the lower animals. The symptoms are analagous to those in man, and frequently continue, in more or less aggravated form, for several weeks, or even months. Digestion is impaired, appetite becomes capri-

cious, is sometimes entirely gone, at other times is morbidly increased; there are spasms, and subsequently torpidity of the bowels. These symptoms simulate those of stomach staggers in horses, and impaction of the third stomach of cattle—disorders for which lead poisoning has been mistaken. Distinctive features shortly, however, present themselves. Along the margins of the gums appears a grey or blue line of lead deposited in the connective tissue, blackened by hydrogen sulphide present in the mouth, or sulphur in the food. Colic and constipation are not so invariably present in the lower animals as in human patients. The extensor muscles of the limbs are cramped and paralysed earlier and more seriously than the flexors. The affected muscles gradually waste. The motor area of the central nervous system is more notably involved than the sensory, and choreic movements and convulsions are succeeded by paresis.

Mr Shenton, a veterinary surgeon practising in Derbyshire, in the autumn of 1861 had eleven **horses poisoned**, and several cattle, and thus described to me the conditions which came under his observation:—"There was a rough staring coat, a tucked-up appearance of the abdomen, and a slightly accelerated pulse; in fact, symptoms of febrile excitement, which usnally, however, passed away in about a week. About this time large quantities of grey-coloured matter were discharged from the nostrils, and saliva from the mouth; but at no time was there any enlargement of the sub-maxillary, lymphatic, or salivary glands. Neither was there constipation of the bowels, which appears to be nearly always present in lead poisoning in man. Fits and partial paralysis came on at intervals; and when the animals got down, they often struggled, for a long time ineffectually, to get up again. The breathing up to this period was pretty tranquil, but now became so difficult and laboured that the patients appeared in danger of suffocation. The pulse was in no case above sixty or seventy; and I ascribed the difficulty of respiration to a paralysed state of the respiratory apparatus. The animals did not live more than two or three days after these symptoms appeared. The post-mortem appearances varied little. The lungs and trachea were inflamed; the lungs engorged with

large quantities of black blood; the trachea and bronchi filled with frothy spume. In all cases but two, the villous portion of the stomach presented isolated patches of increased vascularity; and in all cases the intestines, and especially the large ones, were inflamed. The blind pouch of the cæcum was nearly gangrenous. There was nothing remarkable about the liver, spleen, or kidneys, except that they were of a singularly blue appearance. The brain and spinal cord were not examined."

Mr Cartwright, of Whitchurch, Salop, recorded in the *Edinburgh Veterinary Review*, August 1863, three cases of milk **cows poisoned by eating sheet lead** which had been used for lining tea-chests, had been carelessly thrown on the manure heap, and thence spread on the pastures. Besides failure of milk and appetite, grinding of the teeth, and dulness, several curious symptoms are mentioned. The head was rested against any convenient object as if the animal were asleep; while the pupils were nearly closed, and were little sensitive to light or to movements of the finger. The gait was weak and tottering; while for an hour or two at a time, the cows, although persistently standing on their hind limbs, went down on their knees, propping themselves against the wall. They survived four or five days. From the fourth stomach of one cow a pound of fragments of sheet lead was removed; the lining membrane was thickened, and of a brown colour. The mucous membrane of the stomachs and bowels was unnaturally vascular, and exhibited in places patches of ecchymosis. The liver was pale, clay-coloured, compact, and contained little blood. There was nothing amiss with the urinary organs.

Mr W. Watson, Rugby, records the poisoning of three cows, which languished for several months, and died from eating grass on which the **bullet spray** from the Rugby rifle butts had fallen. Fragments of the lead were found adhering to the coats of the stomach, and the poison was also detected by Professor Tuson of the Veterinary College in the intestines, liver, and kidneys (*Veterinarian*, May and August 1864). Mr Broad of Bath (*Veterinarian*, April 1865) also records cases of cattle poisoned by picking up bullet spray. The

animals were described as dull and tucked up, the eyes staring, the gait unsteady, the appetite good, but the bowels constipated; emaciation and œdema under the jaw made rapid progress. Portions of bullet spray were found in the second and third stomachs; both large and small intestines were pale-blue and bloodless. Professor Tuson recorded similar symptoms from **licking red paint,** which he found retained for twenty-eight weeks in a cow's stomach. Mr Cox of Hendon had several **sheep** become emaciated and paralysed from eating the splashes of lead bullets, which were found in the stomachs in thin flakes readily soluble in the gastric fluids (*Taylor On Poisons*). Lead poisoning proves an occasional cause of abortion amongst cattle.

Mr Herapath reported in *The Chemist* for 1855 interesting cases of lead poisoning which followed the erection of **smelting furnaces** on the Mendip Hills in 1853. The injury appeared to commence half a mile from the chimney, and to extend for half a mile farther. Lead oxides, carbonate, and sulphate were found on the herbage, hedges, and hay. On the live stock "the effects of the metal were stunted growth, leanness, shortness of breathing, paralysis of the extremities, particularly the hinder ones; the flexor muscles of the fore-legs affected, so that they stood upon their toes; swelling of the knees; but no constipation or colic, as in the human species; in a few months death followed. If the injured beasts were removed to another farm, they never throve. In the young the symptoms were more conspicuous and the mortality greater. Lambs were yeaned paralytic; when three weeks old they could not stand, although they made great efforts to do so; in attempting to feed them from a bottle, they were nearly suffocated from paralysis of the glottis; twenty-one died early out of twenty-three. Colts also died, and those that lived could not be trotted 150 yards without distressed breathing. Pigs confined to the sty were not injured, but if allowed to roam were soon affected. The milk of cows and sheep was reduced in quality and quantity, and cheese made from the former had less fat in it. I found in the milk of both minute traces of lead. The dead subjects showed the mucous surfaces to be paler than natural; the lungs had large portions of a dark-red colour,

with circumscribed edges, not like ordinary inflammation, but evidently surcharged with fluid. This accounted for the shortness of breathing, as only portions of the lungs were fit to perform their functions. In some parts there appeared bluish spots, where the powder had been stopped by the bifurcation of the air-passages. A blue line appeared in the gum of the lower jaw, which Dr Taylor said in Court was not caused by lead poison, as it did not occur, as in the human subject, on the upper edge of the gum, but where the gums first come into contact with the teeth, about $\frac{3}{16}$ of an inch below the top edge. I therefore dissected out this line, which was about three-quarters of an inch in length, and the thickness of sewing cotton; and, by aid of carbonate of soda and the blow-pipe, reduced a spangle of lead from it, quite visible to the jury without the aid of a microscope. I was agreeably surprised at this result, as I expected the mark arose only from altered blood; but it will now become, in the hands of a good blow-pipe manipulator, the most ready means of detecting lead in the dead subject. It will be observed that, of the symptoms, those of emaciation, paralysis, and the blue line, are similar to those of the human subject; that constipation and colic are absent; and we get two new ones, shortness of breathing and swelled knees. I will merely add that the Company agreed, without calling witnesses, to pay £500 damages, and to buy the estate at full value."

Lead is **readily found** in the bodies of animals thus poisoned. It has been detected in the blood, the contents of the stomach and intestines, the brain and spinal cord, the muscles, lungs, spleen and liver. Lead salts in solution give with hydrochloric acid a white crystalline precipitate ($Pb\,Cl_2$), redissolved partially or wholly when heated, but reappearing on addition of ammonia solution, which throws down the hydrate ($Pb\,(OH)_2$). Hydrogen sulphide and ammonium hydrosulphide precipitate the black sulphide (PbS). Sulphuric acid and soluble sulphates precipitate the white sulphate ($Pb\,SO_4$). Potassium iodide and bichromate give yellow precipitates of iodide ($Pb\,I_2$) and chromate ($Pb\,CrO_4$).

Lead **enters the bodies of animals** in their food or water,

portions of metal are picked up, or paint is licked. The poison is sometimes brought to the farm in street manure. Water is liable to contamination by conveyance through leaden pipes, or storage in leaden cisterns. The hounds at the Royal Kennels at Ascot some years since suffered from paralysis from drinking water contaminated by passing through new lead pipes. At Claremont the late Louis Philippe and his suite had symptoms of lead poisoning, although the amount of lead did not reach one grain to the gallon. On lead pipes or vessels the conjoined action of **air** and **soft water** is liable to produce a crust of carbonate ($Pb\ CO_3$) with variable proportions of hydrate ($Pb\ (OH_2)$. This crust crumbles away as a crystalline powder, partly dissolved and partly suspended in the fluid. Leaden vessels or vessels soldered with lead, must therefore be used with caution for storage, especially for any length of time, of water, saccharine or acetic solutions, or other fluids likely to dissolve the metal. This caution is especially applicable to soft waters, and to those rich in chlorides, nitrites, nitrates, and nitrogenous matters yielding ammonia. Hard waters, abounding in carbonates, sulphates, or phosphates, are less liable to contamination, as their acid, uniting with the lead, forms an insoluble crust, which protects the metal from further action of air or water. But even such hard waters are not absolutely safe from lead contamination. A piece of iron, patch of soft solder, or a few carbonaceous or other impurities in the lead, are liable to set up galvanic action, and thus dissolve the metal. Great care should therefore be taken to prevent lime, mortar, nails, or in fact any foreign body, getting into leaden cisterns, which should further be emptied and cleaned out frequently, especially when new.

In acute poisoning an emetic or the stomach-pump is promptly used, followed by the appropriate **antidotes**. In chronic poisoning the lead, whether deposited in the tissues or lodged in the digestive canal, should be rendered insoluble, by administration of sulphur, potassium iodide, or magnesium sulphate. The two latter antidotes, each repeated thrice daily, are most to be relied on, and are followed up by occasional doses of oil which removes the lead salts as they are excreted into the bowels.

LEAD OXIDES. Plumbi Oxidi. Litharge. Red Lead.

LEAD CARBONATE. Plumbi Carbonas. White Lead Ceruse.

There are five **oxides** of lead. The plumbous oxide, (Pb_2O) is a black powder obtained by heating lead oxalate, ($Pb\ C_2\ O_4$). Litharge ($Pb\ O$) is a yellow scaly powder prepared by thoroughly heating the metal, and which, by further fusion and action of oxidising agents, yields the higher oxides.

Lead Carbonate, or white lead, is prepared in various ways. In the Dutch process, lead castings are placed over pots containing vinegar, and covered by alternate layers of stable-manure and spent tan. The lead is gradually oxidised, then converted into acetate, which in its turn is decomposed, and the basic carbonate is formed, having generally the formula $Pb\ CO_3.\ Pb\ (OH)_2$.

ACTIONS AND USES.—Litharge and white lead are used topically as desiccants and astringents. Mixed with linseed oil, glycerin, or vaselin, they form antiseptic astringent protective coverings useful in burns, herpes, and moist eczema. Animals however are prone to eat or lick such dressings, and to obviate any risk of poisoning zinc oxide and carbonate are hence usually substituted.

LEAD OLEATE. Lead Plaster. Emplastrum Plumbi.

The common sticking or diachylon plaster is prepared by boiling together gently, by the heat of a steam bath, 5 parts litharge in fine powder, 10 olive oil, and 5 water, keeping them simmering for four or five hours, stirring constantly until the product acquires a proper consistence for a plaster, and adding more water if necessary (B. P.). In this process the oil is decomposed in the same manner as fats are acted upon by steam heat, or by alkalies in the preparation of soap (p. 398), lead oleate rises to the surface, and glycerin remains in solution. Lead plaster is sold in rolls, about a foot in length, of a yellow-white colour, and a faint, sweet, soapy odour. Although brittle when cold, it becomes soft and adhesive when heated.

ACTIONS AND USES.—Lead plaster is adhesive, free from irritant properties, and in this form the lead is not liable to

absorption. For bringing together the edges of wounds it is generally used spread on linen or calico, and thus applied besides affords protection and support. Lead plasters are rendered more adhesive, and consequently better adapted for most veterinary purposes, by melting with every pound four ounces of pitch or resin and two ounces of hard soap.

Lead Iodide. Plumbi Iodium. $Pb\ I_2$.

When equal parts of lead nitrate and potassium iodide are dissolved, and the solutions mixed, double decomposition occurs, potassium nitrate remains in solution, and lead iodide is precipitated in brilliant, golden-yellow crystalline scales, or in a fine, bright yellow heavy powder. It is tasteless, colourless, sparingly soluble in cold water, but readily dissolved by boiling water.

Actions and Uses.—It resembles other lead salts; is occasionally prescribed as a gland stimulant, and applied as a dressing for ringworm and for indolent tumours, being used in the form of ointment or plaster.

Lead Acetate. Plumbi Acetas. Sugar of Lead. Neutral Acetate. $Pb\ (C_2H_3O_2)_2\ 3Aq$.

Lead Subacetate. Liquor Plumbi Subacetatis. Goulard's Extract. $Pb\ (C_2H_3O_2)_2.2PbO.Aq$.

Two lead acetates are used in medicine—the neutral acetate, or sugar of lead, and the tribasic, which occurs in Goulard's Extract.

Sugar of lead is obtained by dissolving litharge in excess of acetic acid; or by exposing it to acetic acid vapour; and also by immersing castings or coils of lead in dilute acetic acid, scraping off the crust of subacetate and subcarbonate which accumulates, dissolving it in acetic acid and evaporating. Lead acetate is sold in minute needle-like crystals, which are slightly efflorescent, have an acetous odour, and a sweet astringent taste; it is soluble in about twice its weight of water at 60° F., and in solution unites with different proportions of the oxide, forming subsalts.

The **liquor plumbi subacetatis,** or Goulard's Extract, is

prepared by boiling 5 ounces of acetate of lead, and $3\frac{1}{2}$ ounces oxide of lead, in powder in a pint of water, for half an hour, constantly stirring; then filter, and, when the liquid is cold, add to it more distilled water, until the product measures twenty fluid ounces. Keep the clear solution in stoppered bottles. (B. P.) It is a colourless transparent, alkaline liquid, has a sweet astringent taste, and unless concentrated becomes turbid on exposure. From a solution of the neutral acetate it is distinguished by its alkalinity; by the copious white precipitate thrown down when a stream of carbonic acid is passed through it; and by its producing an opaque white jelly when mixed with gum arabic mucilage.

Actions and Uses.—The acetates exhibit the physiological actions of other soluble lead salts. They are prescribed as astringents and styptics, and externally as astringents and sedatives. The lead acetates are less corrosive and astringent, and more soothing, than zinc or copper acetates. The greater solubility of Goulard Extract renders it more active than the sugar of lead, and it is preferable for external application, on account of its not drying or crystallising.

Toxic Effects.—Hertwig gave a pound of sugar of lead to **horses,** and observed nausea, colic, a quick, small, hard pulse, stiffness of the limbs, paralysis of the optic nerve, and sometimes of other parts, insensibility, and often death. Even more energetic effects occur in **cattle.** Prinz observed that half an ounce given daily for three days produced in cows fever, with a quick throbbing pulse, colic, and other symptoms of abdominal pain, in one case mania, but in none death. Mecke found that eight ounces, dissolved in water, and given in divided doses during two days, destroyed nine cattle; the first on the second, the last on the fourteenth day after the poison had been given. Early in 1857 a farmer near Glasgow lost eight cows from their boiled food having been stored in a large tub obtained from a chemical manufactory, and impregnated with sugar of lead. The symptoms were similar to those above recorded. **Dogs** receiving half an ounce retained by tying the œsophagus, produced intense intestinal irritation, and death occasionally in nine hours, but sometimes only after two or three days (*Orfila*). Owing to

chemical action, the membrane of the stomach is grey, of a macerated appearance, and sometimes vascular, especially in cases that survive long. Similar symptoms and appearances are observed when sugar of lead is absorbed from a wound, or injected into the veins.

Medicinal Uses.—Lead acetate is administered to check hæmorrhages, especially from the stomach and lungs. It used to be prescribed in purpura in horses and red-water in cattle, but other remedies are more effectual. Half-drachm doses each of sugar of lead and opium, given daily, sometimes check the dangerous diarrhœa and dysentery which attack badly-managed anæmic cattle in autumn and early winter. Scouring lambs are equally benefited by eight or ten grains each of lead acetate and opium. In many of these cases, besides being given by the mouth, it is also added to starch injections.

Externally it is applied to check superficial circumscribed inflammation; to soothe and heal burns, bruises, and irritable moist ulcers; to cool and relieve strained, inflamed tendons and joints; in conjunction with a dose of physic, to abate the itching of nettle rash and erythema; to remove the vesicles and irritation and heal the excoriations of herpes circinatus; to limit the pimples and surrounding inflammation of acne; to arrest irritation and discharge in the moist stages of eczema, in such cases being advantageously alternated with dilute alkalies, sulphur or citrine ointments, or yellow wash. For eye cases it is unsuitable, as the lead albuminate is apt to form a film over the cornea.

Doses, etc.—Of the lead acetates, horses and cattle take ʒss. to ʒi.; calves and sheep, grs. x. to grs. xx.; pigs, grs. ij. to grs. iv.; dogs, grs. j. to grs. iv.; given in bolus or solution, repeated once or twice a day. For external application, sugar of lead is used in powder, ointment, or dissolved in 20 to 40 parts of water, with a little vinegar, to increase its solubility. Goulard's Extract, diluted with 4 to 6 parts of linseed or olive oil, is a cooling application for blistered or contused surfaces. An equally serviceable astringent and anodyne is made with one part of extract to 6 or 8 of vaselin or glycerin. Equal parts of extract and spirit, diluted with 8 or 10 parts of water, make a useful refrigerant astringent. One part of lead

acetate and $\frac{3}{4}$ part zinc sulphate, dissolved in 30 or 40 parts of water, constitute the familiar **white lotion**, and although the preparation is not chemically a correct one, every-day experience proves it to be a serviceable astringent, sedative, and antiseptic.

LINSEED.

FLAX or LINT SEEDS. Semena Lini. The dried ripe seeds of Linum usitatissimum (B. P).

LINSEED OIL. Oleum Lini. The oil expressed, in Britain, without heat, from linseed (B. P.).

LINSEED MEAL. Farina Lini. Linseed, or the cake left after expression of the oil reduced to powder. *Nat. Ord.*—Lineæ.

The Linum usitatissimum, or common flax, cultivated in Britain and other European countries, yields several important articles. The stem affords lint and tow; the seeds, crushed, ground, and subjected to hydraulic pressure, yield linseed oil; the residual cake is a valuable feeding stuff, and when reduced to powder constitutes linseed meal.

The fibrous stem is utilised by steeping in water, generally used hot; starch and cellulose are got rid of by scutching; the fibres are hackled and carded, the shorter coarser portions forming **tow,** the finer, when bleached, are made into **linen.** Soft loosely woven linen, when scarified, and the cut fibres scraped into guazy down, constitutes **surgeon's lint.** Both lint and tow, as well as **jute**—the prepared fibre of hemp—are employed as protectives for wounds. When saturated with hot or cold water, they prove cleanly substitutes for poultices. For cleansing wounds they are preferable to sponges, which are apt to retain and distribute septic germs, while the rag, lint or tow is thrown away after use. These fibrous materials, saturated with carbolic and boric acids, are used for antiseptic dressings. **Oakum,** consisting of detached fibres of old ropes, when treated with Stockholm tar, is also a cheap antiseptic dressing.

Lint seeds are about two lines long, smooth, and shining, of

a brown colour and oval shape, flattened laterally, and pointed at one extremity. They are inodorous, but have an oily, mucilaginous taste. They consist of about 20 per cent. of mucilage, wholly present in the envelope of the seed, and hence only properly extracted by prolonged steeping or slow boiling; 20 of albuminoids; a little sugar; 25 to 30 of oil contained in the albumen and embryo; 5 to 6 of mineral matters, chiefly phosphates, mostly stored in the husks; 5 to 8 of fibre, and 8 to 10 of water. The seeds, ground and pressed without the aid of heat, produce about 25 per cent of oil of the best quality; steam heat extracts 25 to 35 per per cent. The residual **linseed-cake** or oil-cake contains 10 to 13 per cent of oil.

Linseed oil is viscid, has a pale yellow colour, a faint odour, a mild but nauseous taste, and a specific gravity of about 939. It consists largely of olein, or of a variety recognised as linolein. Although it does not solidify until cooled to $-15°$ or $-20°$ F., at ordinary temperatures it oxidises and becomes viscous, hence receiving the title of a drying oil. This drying property is much increased by boiling, or heating it with litharge or black oxide of manganese. It is insoluble in water, soluble in five times its weight of boiling alcohol, in forty parts of cold alcohol, and in one and a half of ether. Boiled with alkaline solutions, it forms soaps. Mixed with an equal quantity of lime water, it forms **carron oil,** a useful dressing for burns and scalds. Exposed for some hours to a high temperature, it becomes a dark tenacious mass, which, when mixed with lampblack, constitutes **printer's ink.** It is sometimes adulterated with rapeseed oil; but is more commonly of inferior quality from rancidity, from preparation at high temperature, or from presence of impurities.

ACTIONS AND USES.—**Linseed and linseed cakes** are valuable feeding stuffs for cattle and sheep, and, in restricted amount, for horses. As fat producers, such oleaginous substances are generally regarded as two and a half times more effective than starch or sugar. They are emulsionised mainly by the pancreatic and biliary fluids; they are absorbed chiefly by the lacteals; and their combustion develops heat and force. In moderate amount they favour assimilation alike of starchy and

nitrogenous food with which they are very generally given.

Well-boiled linseed gruel, or bruised linseed cake digested in hot water, is a **palatable digestible nutrient** for horses, cattle, and sheep, not only in health, but in sickness, notably in catarrhal and other inflammatory attacks, in tuberculosis, rheumatism, chronic skin complaints, and during convalescence from reducing disorders. In such cases it proves both food and medicine. In febrile cases many horses will sip cold linseed tea when they will scarcely eat or drink anything else. Where the patient is exhausted, the linseed tea is given with milk, eggs, or beef-tea, or with alcoholic or other stimulants. Horses that are bad feeders, have harsh, scurfy skins, or are affected with roaring or thick wind, are usually much benefited, especially while living mostly on oats and hay, by about a pound daily of bruised linseed cake. For healthy hunters and carriage horses, the continued use of linseed cake proves, however, too feeding, and often causes itching. A mess of linseed gruel, or a few ounces of bruised cake given daily to calves or lambs, as soon as they will eat it, not only economically favours growth and early maturity, but is tolerably effectual in warding off attacks of diarrhœa, dysentery, and anæmia.

As a **mucilaginous demulcent,** linseed gruel or decoction is very useful in irritable conditions of the throat, alimentary canal, kidneys and bladder; in poisoning with irritants and corrosives; and as a convenient vehicle for the administration of nauseous or acrid medicines.

Ground linseed makes **good poultices,** especially when mixed with an equal quantity of bran or oatmeal; but the bruised linseed cake is cheaper, less apt to become rancid, and equally effectual in retaining heat and moisture. The common mass employed for making up balls and pills usually consists of equal quantities of linseed flour and treacle. Linseed flour, made into a paste with water, forms a good luting for distilling apparatus.

Linseed Oil has been used **dietetically**; but neither for cattle nor sheep does it answer so well as properly prepared linseed or linseed cake. It has the disadvantage of being too

laxative, and it increases rather than diminishes the quantity of ordinary food consumed. As an adjuvant feeding-stuff for animals in health, I have found it inferior to linseed cake, beans, or oats. One or two ounce doses repeated daily are, however, often beneficial in sore throat and bronchitis in horses, and especially for subjects that will not take linseed gruel or mashes.

Linseed oil, in amounts too large to be digested, acts as a **cathartic**; it is also **emollient.** It closely resembles rapeseed, almond, and other fixed oils; it is scarcely so actively cathartic as castor oil.

Bland and unirritating, it is a valuable laxative in young and delicate horses, in pregnant mares, in influenza, purpura, and other debilitating disorders; in diarrhœa, hernia, and irritable states of the intestine, as well as in overloaded torpid bowels, where aloes and other active purgatives, especially if repeated, might cause dangerous irritation. In these troublesome cases a dose of oil is sometimes given, repeated next day or the day after, and supplemented by two ounce doses of Epsom salt, which is administered twice daily; and by stimulation of the intestinal secreting glands and outpouring of fluid, helps to soften accumulation of dry fæces, and move them onwards. The oil and Epsom salt, with frequent large clysters thrown up with the long tube (p. 139), often safely overcome these attacks of overloaded bowels (p. 283). A dose of oil is usually serviceable in warding off attacks of weed, azoturia, or fulness and itching of the limbs, which otherwise are liable to occur when hard-worked horses have several days' rest. Linseed oil usually produces full evacuations without the nausea, griping, or super-purgation which attend the action of more active cathartics. As with other cathartics, in the treatment of colic it is generally combined with stimulants and anodynes—a draught in common use consists of one pint of linseed oil with an ounce each of ether and laudanum, the stimulant and anodyne being doubled in acute cases and in large horses. For colic, aloes, however, generally answers better than linseed oil. As a constituent of laxative enemas, it is much used.

Two or three ounces of linseed oil, or of a mixture of equal parts of linseed and olive oils, given daily in mash, often

suffice, with the use of enemata, to maintain the bowels of horses in a sufficiently relaxed state throughout catarrhal and other febrile attacks. This treatment is also specially suitable in inflammation of the kidneys and bladder, where it is desirable to keep these organs quiescent, and have their excretory work in great part done by the bowels and skin. An ounce or two of oil, given daily to broken-wind subjects, often relieves them; and Mr Anderson, Glasgow, advantageously combined it with lime-water.

In cattle and canine practice linseed oil is much used as a purgative, especially for young and weakly patients, in advanced pregnancy, in gastro-intestinal derangements, in irritant poisoning, where saline or other active purgatives have been given, and their repetition is inexpedient, and as a convenient menstruum for the administration of croton and oil of turpentine. For calves and lambs it is more gentle and safe than salts. For dogs, especially when young, when the digestive organs are in an irritable state, and when exhausting disease has reduced strength, linseed oil is a suitable laxative, and is more effectual when given with an equal amount of castor oil.

On account of its **lubricant and emollient** properties, linseed oil relieves choking; mixed with well-boiled starch gruel and injected into the rectum, it allays irritation; softening the hard, cracked, or scaly skin, it is applied—often with an alkaline solution—in psoriasis, impetigo, and eczema. As a permanent soothing dressing for hard, dry, irritable surfaces, its drying and liability to rancidity render it, however, less suitable than vaselin or than benzoated almond or cocoa-nut oils. These shortcomings are, however, partially obviated by admixture with about one-fourth of lead acetate solution, which, moreover, increases emollient and soothing effects. The drying properties of linseed oil, possessed in common with poppy, walnut, and cod-liver oils, render it less suitable than olive, almond, rape, or colza oils, or than lard, for making ointments or liniments. Smart friction with oil often reduces fulness of joints and bursæ. Flannel, soaked in hot linseed oil, is sometimes applied for the relief of rheumatism. The "**black oil**" used in many parts of England for bruises, strains, and wounds, is made with a pint of linseed or other

cheap oil, two ounces oil of turpentine, adding six drachms oil of vitriol, and leaving the bottle without the stopper until the heat evolved by admixture of the acid has passed away.

Doses, etc.—As a cathartic, horses take O ss. to O j.; cattle, Oi. to Oij.; sheep and pigs, f℥vj. to f℥xij.; dogs, f℥i. to f℥ij.; cats, fʒi.; administered shaken up with linseed gruel, mucilage, milk, treacle and tepid water, or spirit and water. For horses or cattle it is sometimes mixed with a well-made bran mash.

LIQUORICE ROOT.

Glycyrrhizæ Radix. The root and subterranean stems or stolons, fresh and dried, of Glycyrrhiza glabra. (B. P.) *Nat. Ord.*—Leguminosæ.

Liquorice grows in most countries of continental Europe, thriving on dry, light, sandy soils. The best qualities are raised in England, or imported from Spain and Italy. The perennial herbaceous plants vary from two to four feet in height, and have large irregular yellow-green leaves, and papilionaceous, pale-blue flowers. The long, creeping, fibro-fleshy, branched, perennial roots or underground stems are smooth, brown, cylindrical, and about the thickness of a man's thumb, arrive at perfection about the third year, and have a peculiar sweet and somewhat sickly taste. They are generally preserved in sand. The powder has a yellow colour, a sweet taste, and is soluble in water, and, to a less extent, in alcohol. Besides starch, sugar, and a resinous oil, to which it owes its sub-acrid taste, it contains about 6 per cent. of a sweet, yellow, uncrystallisable, unfermentable sugar, termed glycyrrhizin. The natural juice or watery infusion, concentrated until it becomes solid, forms the extract or black sugar.

Actions and Uses.—Liquorice resembles sugar and treacle in its dietetic and medicinal uses. It is occasionally used as a demulcent, in irritation of the pulmonary mucous membrane, for making up boluses, and covering the disagreeable taste and odour of various drugs.

MAGNESIUM AND ITS MEDICINAL SALTS.

Magnesium salts are obtained from dolomite or magnesian limestone, from magnesite, a native carbonate, from talc, from meerschaum and other silicates, and from sea-water.

Magnesium salts give negative results with hydrogen sulphide and ammonium hydro-sulphide. Like other salts of the alkaline earths, they produce, with potassium or sodium carbonate, white precipitates, which are basic carbonates. They give gelatinous white precipitates of hydrate with caustic potash and soda, insoluble in excess, but soluble in solution of ammonium chloride, owing to the property which magnesium salts have to form double soluble salts with ammonium salts; while the characteristic reaction is the precipitation of the crystalline white ammonia magnesium phosphate ($Mg\ (NH_4)\ PO_4$), when a magnesium salt in solution is treated with ammonia and sodium phosphate. A solution of iodine in caustic potash gives a reddish-brown precipitate, decolourised by excess of caustic potash.

Magnesium salts, when swallowed, are not rapidly absorbed, and do not cause any toxic effects. The oxides and carbonates are antacids and laxatives; the sulphate is purgative and febrifuge.

MAGNESIUM OXIDES. Magnesia. Calcined Magnesia. Mg O.
LIGHT CALCINED MAGNESIA. Magnesia Levis.
HEAVY CALCINED MAGNESIA. Magnesia Ponderosa. (B. P.)

Magnesia is usually prepared by heating the carbonate to redness, in partially covered crucibles, until water and carbonic acid are expelled. It is also got by mixing solutions of caustic potash and of any magnesian salt.

It is a white odourless powder, with a slightly earthy taste; is very sparingly soluble in water; has much affinity for moisture, but little for carbonic acid. Two varieties occur, differing only in their density—the lighter, **magnesia levis**, prepared from the light carbonate; the heavy, **magnesia ponderosa**—$3\frac{1}{2}$ times the weight of the other—prepared from the heavy carbonate.

ACTIONS AND USES.—Magnesia is antacid and laxative.

The oxide and also the carbonate are sparingly absorbed, chiefly as chlorides. They resemble potash, soda, and their carbonates, but lack their stimulating effect upon the mucous membrane and their diffusive, solvent, and diuretic properties. Their laxative effect and absence of causticity distinguish them from corresponding lime salts.

Magnesia does not purge either horses or cattle; but is a **gentle laxative for dogs and cats,** to which it is occasionally prescribed with calomel, jalap, or buckthorn. Its laxative effects are increased when the bowels contain acid secretions. For foals and calves suffering from acidity and flatulence, acids and bitters are usually the appropriate treatment; magnesia, however, is sometimes prescribed, but must not be too freely or continuously used, as it is apt to concrete and accumulate in the bowels. It is an antidote for poisoning by oxalic and the mineral acids. It removes arsenic from solution, and for this purpose is most effective in the form of the gelatinous hydrate made by adding caustic potash to a solution of the sulphate. It is occasionally applied as a desiccant.

Doses, etc.—Foals and calves, three or four months old, take, as an antacid, ʒss. to ʒi.; dogs and cats, grs. v. to ʒss. It is given suspended in milk or gruel, and conjoined with carminatives.

Magnesium Carbonates. $(Mg\,CO_3)_3\,Mg\,(HO)_2\,4H_2\,O.$)

Light Carbonate of Magnesium. Magnesia alba.

Heavy Carbonate of Magnesium.

When sodium carbonate is mixed with a solution of magnesium sulphate, magnesium carbonate and magnesium hydrate are precipitated. The manner of preparation affects the weight, but not the other properties. Diluted solutions, boiled, yield the light carbonate. Tolerably concentrated solutions, mixed without heat, yield the carbonate which is $3\frac{1}{2}$ times heavier than the other. The former is lighter; and the latter is dense, loose, and granular, more starchy, and under the microscope is found to be partly amorphous, with intermixture of numerous slender prisms. Both varieties are white, odourless, and tasteless, sparingly soluble in water, but more easily

dissolved in hot than in cold water. **Fluid magnesia** usually contains in every ounce 13 grains of carbonate, dissolved in water charged with carbonic acid gas.

The action, uses, and doses of the carbonates are similar to those of the oxides.

MAGNESIUM SULPHATE. Magnesii Sulphas. Epsom Salt.
$Mg\ SO_4.\ 7\ H_2O.$

Magnesium sulphate is present in various rocks and soils, in the proportion of 15 to 20 grains in the pint of sea-water, and in some mineral springs. It derives its vernacular name from the mineral springs of Epsom.

PREPARATION.—It is obtained **from several sources** :—

(1) **Dolomite**—a double carbonate of lime and magnesia—is calcined ; washed to remove part of the lime ; treated with diluted sulphuric acid when calcium and magnesium sulphates are formed. The calcium salt, being insoluble, is precipitated ; the magnesium sulphate in solution is syphoned off, evaporated, and crystallised.

(2) **Bittern,** the mother-liquor, left when sea-water is concentrated for separation of common salt by treatment with sulphuric acid, also yields magnesium sulphate.

(3) **Kieserite** ($Mg\ SO_4.\ H_2O$), from the Sassfurt salt beds, when digested with water, is gradually converted into $Mg\ SO_4.\ H_2O.\ 6\ Aq.$

PROPERTIES.—Epsom salt is usually sold in transparent, colourless, minute, right rhombic prisms ; but by slow crystallisation it is got in large prisms. It has a cooling, saline, nauseous, bitter taste ; is insoluble in alcohol, but soluble in its own weight of temperate water, and in three-fourths of boiling water. When heated, it fuses in its water of crystallisation ; but as the temperature is raised the water volatilises, and a colourless glass remains. It **resembles** zinc sulphate, from which, however, it is distinguished by its saline bitter taste, by absence of metallic astringency, and by its neutral solution giving no precipitate with hydrogen sulphide. Epsom salt is distinguished from Glauber salt by its neither efflorescing when exposed to air, nor communicating any yellow colour to the flame of alcohol. From oxalic acid, for which it has been

sometimes mistaken, it is distinguished by its finer and more needle-like crystals, its bitter taste devoid of acidity, and its precipitating alkaline carbonates without effervescence.

Actions and Uses.—Epsom salt is purgative, alterative, and febrifuge. As a purgative, it resembles common and Glauber salts, and is more active than potassium bitartrate or sodium phosphate.

General Actions.—When swallowed, it causes outpouring of **secretion from the walls of the small intestines.** Neither pancreatic fluid nor bile are materially increased. The secretion is most quickly produced, and most abundant where the bowels are partially emptied by several hours' fasting. But Epsom salt has a low diffusing power. It is slowly absorbed, especially from the stomach of the cat; and, moreover, it retards diffusion and absorption of fluid present in the canal. In this twofold manner—by (1) **increased secretion** and (2) **retarded absorption**—the fluid contents of the bowels are increased, producing more or less mechanical distension, and provoking some amount of peristalsis. But Epsom salt, like other salines, has only a limited power of stimulating the muscular movements of the intestines. The retarded removal of accumulating liquid is apt to induce flatulence, which is relieved by conjoining carminatives; while effectual removal of the intestinal fluids is attained by using, with the saline, some aloes, oil, or calomel.

In the small intestine, some of the magnesium sulphate is decomposed, its acid portion is more readily absorbed than its basic; part is returned into the intestine, but the greater part is excreted in the urine. Meanwhile, unchanged portions of the salt also undergo slow and gradual absorption but this is checked when purgation occurs. After a few hours the free acid and undecomposed salt are excreted by the kidneys, and more or less diuresis ensues. A smaller amount is also removed by the skin, notably in men and horses, and when the saline is determined to this excretory channel by warmly clothing the body.

Free secretion from the intestinal walls, and the subsequent more limited excretion from the kidneys, necessarily removes both fluid and saline matters from the blood; and within a

few hours this loss is in great part made good by **absorption of lymph and fluid from the tissues.** Mainly in this manner result the febrifuge and alterative effects of salines, their lowering abnormal temperature, and their abatement of dropsical effusions.

Dr Lauder Brunton demonstrated, experimentally, the effect of Epsom salt in causing **outpouring** of **mucous fluid** from the intestinal walls. He placed four ligatures round the intestines of a cat, so as to make three separate closed sacs from five to seven inches long. Into the two outside sacs water alone was introduced; into the centre one was injected 7 grains Epsom salt, dissolved in 105 minims of water. The cat was killed four hours later; and although the two outside sacs were quite empty, the middle one, into which the purgative had been injected, contained 320 minims of pale amber fluid, of the nature of a secretion rather than an albuminous exudation. In two similar experiments, 425 and 250 minims of fluid were found, four and five hours after injection of 85 and 90 minims of saturated solution of Epsom salt. No congestion or inflammation was noticed. The loops on either side, which had been filled with the same quantity of water, were empty. Croton oil, elaterium, and gamboge, tested by like experiment, all caused similar secretion, but none so abundant as Epsom salt, which yielded 42 to 56 minims per square inch of intestine acted on by the purgative.—(*The Practitioner*, May and June 1874).

Professor Rutherford's experiments on dogs demonstrate that magnesium sulphate, unlike sodium and potassium sulphates, has no stimulant action on the liver (*British Medical and Surgical Journal*, November 1875). It nevertheless notably **counteracts "biliousness,"** alike in men and animals by sweeping away unabsorbed bile, generally present in the duodenum, and which, unless removed, becomes reabsorbed.

Epsom salt injected into the circulation does not produce intestinal secretion, but 5 grains to the pound of body weight were proved by Dr Matthew Hay to produce powerfully **toxic effects** in cats and other animals, paralysing first the respiration and afterwards the heart, abolishing sensation, or paralysing the sensory motor reflex centres. (*Journal of Anatomy and Physiology*, vol. xiv; *Lancet*, April 21st 1883).

The several domesticated animals are differently affected by Epsom salt. On **horses,** unless given in combination, it acts uncertainly. Full doses sometimes cause violent catharsis, occasionally produce considerable diuresis; but two to three ounces repeated daily are convenient alteratives and febrifuges. On **dogs** the purgative effect is irregular, and often accompanied by vomiting. For **cattle and sheep** it is a convenient and effectual cathartic, inducing copious fluid evacuations, usually in twelve or fifteen hours.

MEDICINAL USES.—**For ruminants** it is **the purgative** in most frequent and general use. In indigestion, constipation, and in the earlier stages of many cases of diarrhœa, it clears the bowels of undigested fermenting food, of irritant matters, and occasionally of worms. Horses liberally fed on cut dry food, or tough over-ripened green fodder, are subject to overloaded bowels, and in such cases, with restriction to fluid food, and in conjunction with one or two doses of linseed oil and copious clysters, two ounces Epsom salt repeated twice daily, help to moisten, soften and expel the dry impacted intestinal contents. Emptying the bowels and removing excrementitious products from the blood, it lowers abnormal temperature and blood pressure, and relieves febrile and inflammatory conditions.

Although not a desirable purgative for horses, it is a **useful febrifuge.** One to three ounces, given in influenza, pneumonia, and indeed in most febrile and inflammatory disorders, improve the appetite, abate noisome clamminess of the mouth, lessen fever, and help to establish and maintain a healthy and regular action of the bowels. For such febrifuge purposes, whether in horses or cattle, it is given once or twice daily, but should be withheld or diminished in amount whenever the bowels become unduly relaxed, or where flatulence or spasm follows its use. It acts more certainly and regularly when given in solution than in bolus. It is often conjoined with nitre and other salines, and during convalescence from acute disorders, with powdered gentian and other carminatives. Epsom salt is one of the best **antidotes** for poisoning by salts of **lead** and **barium**; it converts them into insoluble sulphates; and further evokes the action of the bowels, which, in lead poisoning, is apt to be

impaired and tardy. In smaller and repeated doses it acts as a diuretic, but is seldom specially used for that purpose. It is frequently added to laxative clysters.

Doses, etc.—As a cathartic, adult cattle take lbj. to lbjss., calves of two to three months, ℥iij. or ℥iv.; sheep and pigs, ℥iv. to ℥vi.; dogs, ʒii. to ʒiv. One-fifth or one-eighth of these doses are often effectual in removing indigestion, keeping up the action of other cathartics, and as febrifuges and alteratives. Epsom salt is given dissolved in ten or fifteen parts of water. To conceal its nauseous bitter taste, it is administered with treacle or with sulphuric acid, in the proportion of about five drops to every ounce of salt. To expedite its purgative action and prevent nausea and griping, there is usually added some carminative, such as a drachm of ginger to the ounce of salt. To insure prompt and full purgation in cattle or sheep, a mixture of equal weights of Epsom and common salt is preferable to either given alone; a like quantity of treacle and a full dose of ginger are added, and solution is effected in a liberal amount of tepid water. In impaction of the third stomach and obstinate constipation among cattle, it is sometimes requisite to add to such saline purges twelve or fifteen croton beans, a drachm of calomel, or half an ounce of gamboge, and to follow this up with repeated doses of treacle and ginger. In atonic torpidity of the bowels it is conjoined with half a dose of aloes and thirty grains of nux vomica. For febrifuge and alterative purposes, in any class of patients, Epsom salt is conjoined with nitre, mineral acids, gentian, and other bitters.

MARSH MALLOW ROOT.

Althæa Radix. Dried Root of Althæa officinalis. *Nat. Ord.* —Malvaceæ.

The plants of the natural family Malvaceæ are rich in mucilage, and most yield tenacious fibres, from which cordage is obtained. The several species Gossypium have their seeds surrounded by delicate, flattened, twisted hairs, which constitute **raw cotton**; while the seeds by expression yield the bland

cotton seed oil often substituted for olive oil. The **marsh mallow grows** both in this country and on the Continent, generally in the neighbourhood of rivers and salt marshes. Mucilage is yielded by most parts of the plant, notably by the two and three year old roots, which contain about 35 per cent each of mucin and starch, and a little uncrystallisable sugar.

ACTIONS AND USES.—Marsh and also common mallow roots are digested with boiling water, and the mucilage thus extracted, and resembling that of linseed, is used as a demulcent.

MERCURY AND ITS MEDICINAL COMPOUNDS.

MERCURY. Hydrargyrum. Quicksilver. Hg.

From its mobility and volatility, this metal is named mercury; to its silvery appearance it owes its synonyme hydrargyrum; to its mobility and metallic lustre such appellations as aqua argentum, aqua metallica, and quicksilver. Although occasionally found in metallic globules, its most important source is the sulphide or cinnabar, (HgS). When the ore is roasted or heated with iron or lime, sulphur is got rid of, and mercury distils over.

Mercury is easily distinguished by its mobility, liquidity, and silver-white lustre. It is tasteless and odourless; freezes at -40° F. forming octahedral crystals; slowly volatilises at all temperatures; and boils at 662° F. forming a dense colourless gas. Its specific gravity at 60° is 13·6, its atomic weight 200. It is diatomic, forming, like copper, two series of salts, the lower or mercurous, the higher or mercuric. When pure its globules roll readily over a sheet of white paper without losing their spherical shape, or leaving a stain. It readily forms amalgams with other metals; with about four parts of tin the silvering is made for looking-glasses. Triturated with fatty or saccharine substances, as in the preparation of mercurial ointments, liniments, and pills, the metal loses its fluidity and globular structure, is reduced to the condition of a dark-grey powder, while a small portion is oxidised.

CHEMICAL TESTS.—Metallic mercury is identified by the characters already mentioned; its several salts are distinguishable by the following tests:—(1) Slightly heated in a quarter-inch test-tube with dry sodium carbonate, they undergo decomposition, their metallic portion volatilising, and condensing in the cool part of the tube in minute metallic globules. (2) When a neutral solution, whether organic or inorganic, whether containing a mercurous or mercuric salt, has a slip of clean copper placed in it and heat applied, metallic mercury condenses on the copper. (3) When a drop of a solution of a mercury salt is placed upon a sovereign, and a key or other piece of iron applied so as to touch at the same time the gold and the solution, a current of electricity is evolved, which decomposes the salt and precipitates its mercury on the gold as a dark-grey stain, easily removable by heat.

Mercury forms **two series of salts**. (1) The mercurous, which are univalent; (2) the mercuric, which are bivalent.

Mercurous salts in solution (*a*) treated with hydrochloric acid, produce a white precipitate of calomel (Hg Cl). Silver and lead have similar white insoluble chlorides; and these three are distinguishsd by their behaviour with ammonia solution, which blackens the mercurous chloride, dissolves the silver chloride, but leaves the lead chloride unaltered. (*b*) Hydrogen sulphide gives a black precipitate of HgS and Hg. (*c*) Potassium iodide in diluted solution yields a yellow precipitate of Hg I. (*d*) Potassium chromate gives a light red precipitate of $Hg_2\ Cr\ O_4$.

Mercuric salts (*a*) treated with hydrochloric acid give negative results. (*b*) To this acidulated solution hydrogen sulphide cautiously added throws down a white precipitate ($Hg\ Cl_2 + 2HgS$), which, on further addition of the precipitant becomes brown and then black (Hg S) and is insoluble in dilute acids and ammonium sulphide. (*c*) Caustic potash yields a yellow precipitate of oxide (Hg O) insoluble in excess. (*d*) Potassium iodide gives a precipitate yellow at first but rapidly becoming red ($Hg\ I_2$) soluble in excess either of the mercury or potassium salt. (*e*) Stannous chloride produces a precipitate at first white, consisting of calomel, which, as the

tin salt is added becomes decomposed, and darkens, leaving metallic mercury.

Actions and Uses.—Mercury, mercurous salts, and mercuric salts differ in their local effects. Metallic mercury has no topical irritant action, and is slowly absorbed, unless in the state of vapour. **Mercurous salts** have a very slight topical stimulant action, and are slowly absorbed. But the more soluble **mercuric salts** readily unite with albumin, are corrosive, act as irritant poisons, and are quickly absorbed. **When absorbed,** all mercurials produce the same general effects. Calomel, grey powder or blue pill develop mild degrees of mercurialism, during which recent fibrinous deposits are sometimes broken up. They are also cathartics, especially if conjoined with a small amount of any cathartic. Corrosive sublimate is used as the most effectual germicide. Ointments of mercury and of mercuric iodide, are applied as absorbents and counter-irritants. Mercurials are **excreted** in the saliva, bile, intestinal mucus, urine, and sweat. They pass into the milk of nursing females; and Gasparin has seen lambs die from mercurialism when the ewes have been freely dressed with ointment.

Mercury, so long as it remains uncombined, like other metals, is devoid of physiological action. Several pounds, given to human and veterinary patients for the purpose of removing obstruction of the bowels, produce only mechanical effects. In a state of fine division it is, however, oxidised and dissolved, and thus acquires activity. In this way **mercurial vapours** speedily become **poisonous,** and exert their effects on water-gilders, barometer, thermometer, and looking-glass makers, and others who work with the metal. The volatility and poisonous action of mercury were strikingly illustrated in the case of the "Triumph" man-of-war and "Phipps" schooner, which received on board several tons of quicksilver, saved from the wreck of a vessel near Cadiz in 1809. From the rotten bags the mercury escaped, and the whole of the crew suffered. Within three weeks two hundred men were salivated, two died, and all the animals—cats, dogs, sheep, fowls, a canary bird, nay, even the rats, mice, and cockroaches—were destroyed (*Pereira*). Out of 516 workmen employed at the Quicksilver Works at

Idria, 122 were, in 1856, affected with dyspepsia, scrofula, anæmia, neuralgia, mercurial gout, tremor, and caries. The finely-divided mercury so prevaded the atmosphere, that cows feeding in the neighbourhood of the furnaces suffered from excessive secretion of saliva, became unthrifty and aborted, the calves were also often ailing; while trout in adjacent reservoirs, contaminated by the waste products of the furnaces, lost their red spots and became sickly.

Mercurialism exhibits tolerably uniform appearances in all animals. Secretion and excretion are increased. The abundant flow of saliva, so notable in man, is not, however, observed to the same extent amongst the lower animals. The mouth becomes tender; the gums red, soft, and swollen; the breath fœtid. There is impaired appetite, with nausea, gradual loss of condition, and general weakness. The fæces are increased in quantity, are largely mixed with mucus, and bad-smelling. The functions of the kidneys and skin are exalted. The blood is deficient in fibrin, albumin, and globules; forms a soft friable clot; and is loaded with a fœtid oil. In man there occur peculiar tremors, passing into paralysis, and affecting certain muscles and groups of muscles. Mr Percivall and Professor Williams describe a form of eczema resembling red-mange, and occurring especially in cattle and dogs. Professor Williams gives woodcuts of cancer-like deposits found in the shafts of the long bones of a dog which had been in the habit of lapping vermilion paint.—(*Principles of Veterinary Surgery*).

Mercurialism is producible in any of the lower animals, but with most difficulty in horses, different individuals manifesting, however, various degrees of susceptibility. Thus Mr Percivall, in his *Effects of Medicines*, mentions that ten grains of calomel, given daily to a four-year-old horse, made the mouth so sore by the fifth day that he "cudded" his hay; while a mare had six drachms of calomel, two ounces of blue pill, and mercurial ointment well rubbed into her thighs, without suffering either from sore mouth or salivation. Mercurialism occasionally results from one large dose, when it is apt to be violent and difficult to control; but is induced more certainly and safely by small and repeated doses of calomel, or any mild mercurial; and its production is hastened by using the medicine both ex-

ternally and internally, and by blood-letting, nauseating medicines, or other means which diminish vascular tension and favour absorption.

Control of gastro-intestinal inflammation, absorption of fibrinous exudations, and checking of scaly skin complaints—which are the chief curative effects of mercurials—seldom require the production of full mercurialism, but are more safely effected by three or four small doses of the milder preparations. The patient under the effects of mercury must be carefully protected from cold and wet. To arrest excessive action, the drug must be withheld; its excretion hastened by administration of potassium iodide, followed by a saline purge; and the mouth, if sore, washed repeatedly with solution of chlorinated lime or alum. In poisoning by irritant mercurial salts, the treatment consists in repeated full doses of albumin and other demulcents.

MERCURIAL OINTMENT. Unguentum Hydrargyri.

Mercurial or blue ointment, of good quality, cannot be made on the small scale without immense labour and loss of time. The wholesale manufacturer generally uses equal weights of mercury and hog's-lard, with one-sixteenth part of suet, to impart suitable consistence. The materials are kept in the fluid state by a temperature of about 100° F., and are driven with rapidity round a circular trough by two spherical iron balls, propelled by a steam-engine; and in this way extinction of the globules is accomplished in the course of twelve hours. The process is facilitated by addition of $\frac{1}{16}$ part of old ointment, or a small quantity of potassium nitrate or sulphate. It has a bluish-grey colour, and a specific gravity of 1·78. A good ointment contains about 1 per cent. of its mercury in the state of oxide, and infriction and exposure during application increase this more active oxidised portion, which is dissolved by the salts and fatty acids of the skin. This strong ointment is usually diluted with two or three parts of hog's-lard or soft soap.

ACTIONS AND USES.—Mercurial ointment, when merely laid on the surface of the skin, exerts slight topical effect,

and is only very gradually absorbed. When applied with smart friction, it is more quickly absorbed, and, in considerable amount, **irritates, vesicates,** and induces constitutional effects. Two ounces of the strong ointment, rubbed daily into the skin of a horse, salivates in four or five days. When constitutional effects are desired, the external and internal use of the drug is sometimes concurrently adopted.

A mild dressing sometimes encourages the healing of indolent ulcers, and promotes a healthier action in psoriasis and other persistent scaly skin disorders. For the successful treatment of psoriasis and allied complaints, Professor Williams recommends the internal as well as the external use of liquor arsenii et hydrargyri iodidi (p. 414). Although not superior to many safer remedies, it is sometimes used for destroying tinea and favus, and killing lice and other skin parasites; and for such purposes is frequently conjoined with tar, sulphur, or iodine. As a **counter-irritant** and absorbent, the strong ointment is employed in reducing swelling and thickening of joints and tendons.

Mercurial ointments are apt, however, to be used too freely and indiscriminately. Professor John Gamgee states that a druggist in Boston, Lincolnshire, sold in one year 25 tons of mercurial ointment, mostly to farmers. When incautiously used, they not only cause undue irritation, but are apt to become absorbed. I have known many cattle and sheep, dressed for skin complaints and skin parasites, suffer from mercurial poisoning, and seen a good many of these cases terminate fatally. In Lincolnshire a lot of scabby sheep were treated with blue ointment, and forty died with symptoms of short breathing, a peculiar grunt indicative of pain, and drooping heads (*Taylor On Poisons*).

MERCURIAL LINIMENT. Linimentum Hydrargyri. Mercurial Oleate.

One part each of mercury ointment, ammonia solution, and camphor liniment, thoroughly mixed, constitutes the B. P. liniment. Its effects are similar to those of the ointment. Two

liniments, suitable for persistent scaly skin diseases, enlarged glands, and chronic indurations, are subjoined—

Mercurial ointment,	2 ounces.	Mercurial ointment,	2 ounces.
Camphor,	1 drachm.	Creasote,	1 drachm.
Oil of tar,	4 ounces.	Liquor ammoniæ,	2 ounces.
Linseed oil,	4 ounces.	Linseed oil,	6 ounces.

An oleate is prepared by mixing in a mortar, with stirring, oleic acid and 10 to 20 per cent of mercuric oxide, which should be added gradually. Such a preparation is diffusible and penetrating. It promotes absorption, and, used repeatedly, acts as a counter-irritant. It is applied in articular inflammation, exostoses, indurations of the udder, and other glandular and indolent swellings. Even in diluted solution, it destroys tinea and favus, and is also fatal to skin parasites. Morphine is added to the oleate when anodyne is to be conjoined with absorbent effects.

MERCURIAL PLASTER. Emplastrum Hydrargyri.

Seven parts olive oil is heated, and one part of sulphur, gradually added until they unite. With this mixture triturate 164 parts mercury until globules are no longer visible; then add 328 parts lead plaster, previously liquefied, and mix thoroughly. This plaster is occasionally used as a stimulant for glandular and chronic enlargements, windgalls, and other bursal swellings.

MERCURY WITH CHALK OR MAGNESIA. Hydrargyrum cum Creta vel Magnesia.

These mixtures are made by triturating together one part mercury with two of chalk or magnesia until globules disappear, and a uniform grey colour is acquired. The mercury with chalk, constituting **grey powder,** should be free from grittiness, and insoluble in water; but its chalk dissolves in hydrochloric acid, leaving the mercury in a finely-divided state.

Both preparations are **antacid, laxative,** and **alterative.** Grey powder is given with good effect to young calves and foals suffering from bilious indigestion and diarrhœa, in doses of 5 to 15 grains, repeated once or twice a day, conveniently

placed on the patient's tongue, or administered with a drachm of ginger, either in spirits and water, milk, or a little gruel. To allay gastric irritation, and as an alterative for dogs, 1 to 3 grains are prescribed two or three times daily. In the earlier stages of distemper, Mr Mayhew recommends grs. v. to grs. xv. of grey powder, conjoined with gr. i. to grs. v. of ipecacuan; but such treatment is only applicable in robust patients.

MERCURIAL OR BLUE PILLS. Pilula Hydrargyri.

These pills, so much used in human medicine, are seldom employed in veterinary practice. They consist of two parts mercury, three of confection of roses, and one of liquorice root. The addition to this of about one part of ferric oxide produces a pill mass, which Mr Morton used to prescribe as an alterative for horses, in doses of half a drachm to a drachm. Mr Mayhew recommends, as a cathartic for a medium-sized dog, 5 grains blue pill, 6 grains powdered colchicum, and 10 grains colocynth extract. Five grains blue pill and eight grains compound extract of colocynth, flavoured with a few drops of oil of peppermint or of cloves, make a convenient laxative for a large dog, or two or three doses for a smaller. The activity of mercurial pills in part results from their containing a small proportion of oxide which is readily dissolved by the acid gastric juice.

MERCUROUS OXIDE. Hydrargyri Suboxidum. Hg_2O.

Mercurous, black, grey, or lower oxide is prepared by decomposing calomel (HgCl) with caustic potash solution, and washing with water. It is a heavy black powder, devoid of taste or odour, insoluble in water and alkalies, but soluble in nitric and acetic acids. It is unstable, and on exposure to light or gentle heat decomposes into mercuric oxide and metallic mercury. It is less active than the mercuric oxide, and is frequently used as a **stimulant** for unhealthy wounds and ulcers, in the form of the black wash—the **lotio hydrargyri nigra**—made by mixing thirty grains calomel with ten fluid ounces lime-water.

MERCURIC OXIDE. Hydrargyri Oxidum Rubrum. Red Precipitate. Hg O.

Mercuric, red, or yellow oxide is prepared by decomposing a solution of corrosive sublimate with caustic potash, soda, or lime-water; or by heating equal weights of mercuric nitrate and metallic mercury so long as acid fumes are evolved. Prepared by precipitation, it constitutes the yellow wash or **lotio hydrargyri flava.** The modified form, prepared by heating the nitrate, occurs in orange-red crystals, which become yellow when powdered and brownish-black when heated, recovering, however, their original colour on cooling. It dissolves sparingly in water, but readily in hydrochloric acid.

Mercuric oxide is greatly more active and irritant than mercurous oxide. It is nearly as irritant as corrosive sublimate. Two or three grains given to dogs cause fatal gastro-enteritis. Eight to fifteen grains caused colic in horses, and one or two drachms enteritis and death (*Hertwig*). It is applied externally as a **stimulant** and caustic for indolent ulcers, over-luxuriant granulations, chronic scaly eruptions, and glandular enlargements, being used in the several forms of powder, lotion, or ointment.

MERCURY SULPHIDES. Hydrargyri Sulphuretum.

Cinnabar, a red-brown native mercuric sulphide (Hg S), found in Carniola and Spain, is the most abundant ore of mercury. A black amorphous mercuric sulphide is thrown down when hydrogen sulphide is added to corrosive sublimate, and this black sulphide, when sublimed, is converted into the bright-scarlet **vermilion. Ethiops mineral** is a black unstable mercurous sulphide (Hg_2 S). These sulphides are insoluble and nearly inert. Ethiops mineral used to be given to horses as an anthelmintic and supposed specific for glanders, in doses of ℨi. to ℨiij.; but has deservedly fallen into discredit.

MERCURY SULPHATE. Hydrargyri Sulphas. Turbith or Turpeth Mineral.

The mercuric sulphate (Hg SO_4) is the usual source both of calomel and corrosive sublimate. The insoluble yellow basic

mercuric sulphate, known as **turpeth mineral** ($Hg SO_4 . 2Hg O$), is an active irritant and errhine; half a drachm to a drachm poisons dogs; smaller doses are emetic; but it is not now used in regular practice.

MERCUROUS CHLORIDE. Mercury Sub or Lower Chloride. Hydrargyri Subchloridum. Calomel. HgCl. or Hg_2Cl_2.

Calomel is found native in Carniola and Spain, but in too small amount to be of commercial value. It is obtained (1) by decomposing a solution of mercurous nitrate with a hot solution of common salt; and (2) more commonly by subliming a mixture of mercurous sulphate with common salt.

The several steps in this **sublimation** process are as follows: 2 parts of metallic mercury are dissolved, by aid of heat, with 3 parts sulphuric acid. The resulting mercuric sulphate is mixed with as much metallic mercury as it already contains. The mixture is triturated with $1\frac{1}{2}$ parts sodium chloride, and heated in a suitable apparatus. The calomel, rising in vapour, may be condensed in fibrous cakes on the cool part of the vessel, or conducted into a large chamber, where it falls in fine powder, its minute sub-division being sometimes still further secured by introduction of steam. Traces of corrosive sublimate, which are apt to sublime over, are got rid of by washing with boiling distilled water until the washings cease to be darkened by a drop of ammonium hydrosulphide. The powder is dried at a temperature not exceeding 212° F.

The chief reactions are thus represented—

$$Hg + 2H_2SO_4 = Hg\ SO_4 + SO_2 + 2H_2O$$
$$Hg\ SO_4 + Hg + 2NaCl = Hg_2Cl_2 + Na_2SO_4.$$

As usually sold, calomel is in amorphous powder, dull-white, with a faint yellow tinge. Its spec. grav. is 7·18. It is inodorous, nearly tasteless, insoluble in cold water, alcohol, and ether. It is slowly decomposed by light; volatilises unchanged when heated; yields mercurous oxide when acted on by alkalies or lime-water; and is converted into corrosive sublimate by boiling hydrochloric acid.

ACTIONS AND USES.—Calomel, in full or repeated doses, causes mercurialism. It is prescribed as an adjuvant purgative

and diuretic. It expells bile from the duodenum, and is a sialogogue. It is an emetic for dogs and pigs. Repeated small doses promote liquefaction of lymph, and hence prevent adhesions. Externally, it is used as a desiccant, stimulant, and antiparasitic.

General Actions.—Professor Tuson shewed that calomel and distilled water, digested in a glass vessel at 100°·2 F.—the temperature of the stomach—when mixed with either pepsin or a 2 per cent. solution of hydrochloric acid, remained unaltered, even after twenty-four hours ; but when both pepsin and hydrochloric acid were used, solution speedily occurred, and a black precipitate of mercury sulphide was formed (*Veterinarian,* January 1872). The mucus and fats of the canal, and also the bile, further aid solution of calomel. It is chiefly absorbed as an albuminate. The opinion that it undergoes partial conversion into the higher chloride appears disproved by the fact that the chlorides in the canal are insufficient to effect such a change, while the two mercury chlorides differ in their actions (*Monthly Journal of Medical Science,* 1851).

Toxic Effects.—Irritant effects, usually followed by constitutional effects, although less marked than those of mercuric chloride or nitrate, are produced in horses by three or four drachms ; in cattle, by two or three drachms ; in sheep, by fifteen to thirty grains ; in dogs, by six to thirty grains. Hertwig found that these doses, within twenty-four or thirty-six hours, and in dogs in less time, caused occasional colic and copious excretion of fæces, which contained bile, and were greyish-green in cattle, but darker in dogs. Such doses, especially if repeated daily for three or four days, further induce fluid and stinking evacuations, fœtid breath, soreness of the mouth, rapid impairment of appetite and condition, and fatal low fever and dysentery.

At the Edinburgh Veterinary College, in June 1853, a healthy **donkey** got a drachm of calomel daily in three separate doses. About the sixth day the animal became excitable, and the pulse rose to 85. By the eighth day secretion of saliva was augmented, the breath was fœtid, the gums red and tender, and appetite impaired, but nothing abnormal was observed about the fæces or urine. By the twelfth day these symptoms

became more aggravated ; the pulse softer and less frequent ; the strength much reduced. On the fourteenth day administration of the calomel was suspended, but death occurred two days later. The animal had received fourteen drachms in fourteen days. Post-mortem examination discovered the teeth loose, the mucous membrane of the mouth and air-passages blanched, while that of the stomach and intestines was softened, easily torn, and in many places thickly covered with mucus and epithelium. The liver was rather friable, but the kidneys, spleen, and lungs were healthy.

Dogs weighing 30 lbs. to 40 lbs. receiving three or four grains night and morning, were salivated in a week, and died in nine days. The most notable appearances were inflammation of the large intestines, and of the sympathetic ganglia of the abdomen. Hertwig considers that dogs and swine, on account of their often getting rid of the drug by vomiting, are less easily affected than the other domesticated animals ; and that horses are less susceptible than cattle.

The action of calomel **on the liver** was investigated by the Committee of the British Medical Association, who experimented chiefly on dogs with fistulous openings into the duodenum, and arrived at the conclusion that **neither calomel nor blue pill affect secretion of bile,** unless they purge or impair health, when the quantity of bile is diminished (*Medical Times and Gazette,* vol. ii., 1869). Dr A. Röhrig curarised dogs, maintained life by artificial respiration, and placed a glass tube in the gall duct. Croton oil in doses of 18 drops, introduced into the duodenum, increased or re-established the biliary secretion. Colocynth, jalap, aloes, rhubarb, and senna, acted with a power decreasing in the order named. Castor oil and bitter salts had little effect. Calomel, even in 20 grain doses, did not re-establish the secretion when it had ceased, but had a marked power in increasing and maintaining it beyond the natural time for its cessation (*Stricken's Medicinische Jahrbucher,* 1873).

Professors Rutherford and Vignal, also experimenting on curarised dogs, found that doses of 10, 5, or even 2 grains of calomel placed in the duodenum of fasting subjects produced purging ; they did not, however, increase secretion of bile, but

actually diminished it. Similar negative results occurred even when calomel was introduced into the intestine, mixed with bile or with hydrochloric acid. These repeated experiments justify the conclusion that calomel, and the milder mercurials, have no special cholagogue action; they do not stimulate secretion of bile, as they notably do of saliva, and pancreatic fluid. By reflex action the intestines irritated by the mercurial, propagate stimulant effects to the liver, much in the same way as resinous purgatives, croton, and acid chyme in the duodenum stimulate the liver and contract the gall bladder and hepatic ducts. The increased intestinal action sweeps out bile lodged in the duodenum, as well as in the hepatic ducts, and prevents its reabsorption, while, moreover, it abates congestion of the portal system. Calomel, therefore, **although not increasing secretion of bile, notably hastens its expulsion.**

MEDICINAL USES.—Few remedies have been applied to so many and diversified uses, but neither in veterinary nor in human medicine is calomel as much used as formerly. **Gastric irritation,** intestinal catarrh, as well as bilious diarrhœa, are frequently treated with small doses, either used alone, or conjoined with chalk or opium. For foals and calves, it may be substituted for grey powder (p. 466), when the bowels are irregular, and the discharges malodorous. In such cases calomel, like other mercurials, probably owes its good effects to its antiseptic properties. Calomel is not now regarded as a special remedy for jaundice, or chronic liver complaints, which are more fittingly treated by laxativea, which remove unabsorbed bile, and by nitro-hydrochloric acid which acts as a liver stimulant.

It is a useful **adjuvant purgative.** Four drachms of aloes with half a drachm of calomel, purges most horses as effectually as eight drachms of aloes. Such a combination is advantageously used in weed and other cases where prompt and full catharsis is desired. As an adjuvant purgative, it is more serviceable amongst cattle than in horses. As an **anthelmintic,** combined sometimes with santonin, and followed by a laxative, it removes lumbrici. In acute rhematism calomel is given with a purgative; in chronic cases small doses are sometimes used with quinine sulphate. Dogs and pigs frequently have

calomel conjoined with jalap or with oils as a cathartic and febrifuge, and occasionally with ipecacuanha as an emetic.

As an **alterative** and **febrifuge,** it is not as much used as formerly, but some practitioners still prescribe it in acute inflammation, particularly in pneumonia, pleurisy, peritonitis, laminitis, and iritis. It is usually most effectual, when such cases happen to be complicated with gastric derangement, and its curative action probably depends upon its combination of antiseptic, cathartic and diuretic effects, these latter being increased by the laxatives and salines with which it is usually conjoined. When it is sought to develop the specific effects of mercury in liquefying recently formed lymph, and preventing adhesions, as in iritis, pleurisy or peritonitis, small and frequently repeated doses are used, usually conjoined with opium to delay excretion, while it may also be expedient to hasten the constitutional effects by in-rubbing of the ointment. That type of influenza in horses complicated with gastric derangement and yellow mucous membranes, is often well treated in the early stages with calomel grs. xx., and opium ʒ ss., with or without oil, repeated twice or thrice, at intervals of twelve hours, and alternated with or followed by salines. In enteritis, whether in horses or cattle, Mr Barlow sometimes used half a drachm of calomel, with an ounce of laudanum, in a pint of gruel, repeated at intervals of one or two hours, until three or four doses were taken. Metritis and peritonitis, affecting cows three or four days after calving, are usually relieved by a drachm of calomel, two ounces laudanum, and one pound castor oil, mixed with hot water and treacle. Calomel, chalk, and opium, are frequently prescribed in dysentery.

Calomel has **diuretic** effects ; it notably increases the diuresis caused by resinous or saline drugs. This action is stated to result from its being in part converted into mercuric chloride, which, unlike mercurous chloride stimulates the liver, and increases the amount of urea in the blood (*Brunton*).

Externally calomel destroys the acari of scab and mange, kills lice, abates the itching of those eczematous eruptions which affect the hairy limbs of underbred cart horses, and are also common in dogs. Although of small benefit in soothing

the itching of urticaria, it relieves the irritation of prurigo, removes the scales, and heals the cracks of psoriasis, hastens removal of warts, and is one of the best remedies for thrush in the horses' frog, while in the form of ointment it relieves piles in dogs. It must be used discreetly, for if freely applied it may be absorbed, and cause untoward constitutional effects.

Doses, etc.—As an **alterative** and **febrifuge**, horses and cattle take grs. x. to ʒ i.; sheep and pigs, grs. v. to grs. xxx.; dogs, grs. i. to grs iij; usually given two or three times a day, frequently with an equal weight of opium, to prevent too rapid removal by the bowels. As a **cathartic**, calomel is not used alone and the dose is consequently regulated by that of the drug with which it is combined. For the horse a full purgative consists of calomel ʒ i. with aloes, ʒ iv.; for cattle ʒ i. to ʒ ij, with Epsom or common salt lb. 1, or oil, Oj. For dogs grs. ij. to grs. iv., with jalap, grs. xx. to grs. xl. As a **vermifuge** for the horse, the following combination is given before feeding for three or four consecutive mornings:—One drachm each of calomel, oil of male shield fern and aloes, with four drachms of ginger, made into bolus with linseed meal and treacle. As an **emetic** for dogs or pigs, two or three grains are given, with an equal quantity of tartar emetic, or with grs. xv. to grs. xx., of ipecacuan. To allay skin irritation, promote healthy skin action, or destroy skin parasites, calomel is used in powder, solution, or ointment conjoined sometimes with iodine, boric acid, or wood-tar oils.

Mercuric Chloride. Hydrargyri Perchloridum. Hydrargyrum Corrosivum Sublimatum. Corrosive Sublimate. $Hg\ Cl_2$.

Corrosive sublimate and calomel are both chlorides of mercury; corrosive sublimate contains twice as much chlorine as calomel; is the higher per or mercuric chloride ($Hg\ Cl_2$); and is a soluble and actively corrosive poison; while calomel, the lower or mercurous chloride ($Hg\ Cl$), is an insoluble, comparatively mild medicine. By using, in speaking or writing, the vernacular names, risk of mistaking these chlorides, is diminished.

Corrosive sublimate may be **prepared** by heating metallic mercury in chlorine gas, or dissolviug it in aqua regia. The most common process, however, consists in subliming a mixture of 20 parts of mercuric sulphate, and 16 of sodium chloride, with one of manganese black oxide, which secures oxidation of the sulphate, facilitates liberation of the chlorine, and thus prevents formation of calomel.

It occurs in heavy colourless masses of prisms, or as a dense white powder of broken crystals. It has a spec. grav. of 5·4; is devoid of odour, but has an acrid, disagreeable, metallic taste. When heated, it fuses, boils and emits an exceedingly acrid poisonous vapour. It is soluble in about two parts of alcohol, still less of ether, three of boiling water, and sixteen of cold water. It has an acid reaction on colouring matter, and forms, with albumin and fibrin, flaky precipitates, soluble in solution of common salt. It is decomposed by most vegetable solutions, especially when exposed to light. Its antiseptic properties recommend it for preserving wood, cordage, and anatomical preparations. Its tests have been detailed (p. 461). It is not subject to intentional adulteration.

Actions and Uses.—It is a corrosive and irritant poison; is occasionally prescribed as an alterative, antiseptic, and cholagogue; repeated doses cause mercurialism. Externally, it is used as an antiseptic, astringent, caustic, and parasiticide.

Corrosive sublimate **precipitates albumin**, and hence in powder or concentrated solution, is **irritant** and **corrosive.** It is one of the most powerful of **antiseptics**; one part in 25·250 prevents the development of bacteria taken from meat infusion; one part in 10·250 prevents the development of spores in boiled meat infusion; one part in 6,500 prevents reproduction of spores. Spores placed in 1 per cent. solution in water were effectually destroyed in one to two days (*Koch*). Solution of two grains to the ounce of water effectually destroyed vegetable and animal parasites infesting the skin (p. 27). It must, however, be used with caution, for it not only irritates and corrodes locally, but is readily absorbed, and hence liable to produce constitutional effects.

Toxic Effects.—Swallowed in strong solution it is an **irritant poison,** producing **gastro-enteritis** and **collapse.**

Smaller or more diluted doses become absorbed as albuminates and **produce mercurialism.** Seven or eight grains destroyed dogs in seven to thirty hours; four drachms dissolved in three pounds of water killed a horse in twelve hours; two drachms caused in cattle great emaciation, and death in fourteen days; one drachm proved fatal to a sheep within twelve hours (*Hertwig*). Larger quantities, however, appear to be tolerated when the poison is first given in small doses. Thus Mr Percivall, experimenting upon a horse, commenced with ten grains, and gradually increased the dose to five drachms before the appetite or pulse became affected. Injurious effects occur whatever the channel by which poisonous doses enter the body. Shepherds using strong solutions for foot-rot or for scab, have suffered from its irritant and also from its constitutional effects. Dogs dressed with it for mange have occasionally died from gastro-enteritis.

Compared with arsenical poisoning, the symptoms come on more rapidly; there is more chemical and corrosive action, whilst in chronic cases salivation usually ensues.

Post-mortem examination discovers the mucous lining of the alimentary canal softened and bluish-grey: where large doses have been given, it is disorganised by chemical action; where death is postponed for a day, patches of inflammation and sloughing are found; the kidneys and other urinary organs are congested; the lungs are usually spotted with effused blood.

The treatment consists in the free use of albumin, which forms an insoluble mercuric albuminate. One egg suffices to neutralise four grains of sublimate. When eggs cannot be had, wheat or barley flour, milk, or other albuminoids should be given, followed by astringent solutions. Unless the drug has itself caused vomiting, the stomach must be emptied either by emetics or the stomach-pump.

MEDICINAL USES.—For internal use, milder mercurials are generally preferred. For horses it has been prescribed in farcy, chronic skin eruptions, and swollen œdematous legs resulting from repeated attacks of weed. Like other mercurials, it appears to **promote absorption** of exudate. Half, or even a quarter of a grain, repeated every three hours, sometimes

arrests the slimy, bloody, reducing discharges of persistent diarrhœa and dysentery in cattle. Professors Rutherford and Vignal found that $\frac{1}{8}$ to $\frac{1}{16}$ grain, given to dogs, although not stimulating the duodenal glands, notably **excite secretion of bile**. Conjoined with opium, hemlock, and salines, it has been advised in rheumatism.

As an effectual **antiseptic** it is used for many surgical purposes. Foul wounds washed with one part dissolved in 500 of water are rendered aseptic. Knives and other infected instruments, as well as the hands of the practitioner, are disinfected by washing in such a solution. It **destroys** the cryptogramic growths of **ringworm.** It kills **lice and acari,** and also their spores. It is injected into the uterus in puerperal metritis. In diphtheritic sore throats, a spray of half a grain to an ounce of water is sometimes used. It **allays** the **itching** of pruritus, prurigo, and urticaria. In the latter disease, Professor Robertson recommended mercuric chloride grs. xii., dilute hydrocyanic acid, f℥ iv., glycerin, f℥ ii., water, f℥ x. For **ophthalmic cases,** watery solutions are used containing gr. $\frac{1}{60}$ to gr. $\frac{1}{10}$. Four or five grs. rolled in tissue paper, and introduced deeply into the sinuses of quittor and other fistulæ, in six or eight days slough out the fibrous secreting walls.

With suitable precautions, watery solutions are used for **disinfecting** infected premises, and the carcases of animals, which have died of anthrax or other contagious diseases.

Doses, etc.—Horses and cattle take grs. v. to grs. viij.; sheep and large pigs, gr. j.; dogs, gr. $\frac{1}{16}$ to gr. $\frac{1}{8}$. It is best given freely dissolved in water or other simple fluid. For most external purposes, a **solution** of sufficient strength is made with two to five grains to the ounce of water. To relieve itching, especially amongst dogs, two grains corrosive sublimate and two minims prussic acid are dissolved in an ounce of water. An **ointment** containing 1 part of sublimate to 20 and sometimes 12 parts of fatty matters is used in skin complaints, and for destroying skin parasites.

Ammoniated mercury, or white precipitate, sometimes employed for such cases, is an opaque, white, insoluble powder, made by mixing corrosive sublimate solution, with excess of ammonia solution, and washing and drying the precipitate

(NH_2HgCl). An ointment is made with 1 part of precipitate to 7 of simple ointment.

MERCUROUS IODIDE. GREEN OR LOWER IODIDE. Hydrargyri Iodidum Viride. HgI.

MERCURIC IODIDE. RED OR HIGHER IODIDE. Hydrargyri Iodidum Rubrum. HgI_2.

Mercurous iodide is an unstable salt, prepared by triturating together iodine and an excess of mercury with a little alcohol, or by mixing solutions of mercurous nitrate and potassium iodide. Although not so active as the higher iodide, twenty grains destroyed a rabbit within twenty-four hours, and a drachm a pointer dog in five days (*Cogswell*).

Mercuric or red iodide is a vermilion-coloured, heavy crystalline powder, with a disagreeable metallic taste. It is insoluble in water, sparingly soluble in cold alcohol, but soluble in ether, acids, solution of potassium iodide, and most saline fluids. It is prepared by mixing a solution of corrosive sublimate and of potassium iodide, when mutual decomposition ensues; the precipitate at first is yellow, then fawn, eventually red; the clear supernatant fluid is decanted away, and the precipitate washed with distilled water and dried.

ACTIONS AND USES.—Mercuric iodide is as irritant as mercuric chloride or nitrate. Twenty grains given to a rabbit induced gastro-enteritis and death in twenty-four hours. It is not used internally, but the ointment is applied as a stimulant, counter-irritant, and caustic.

For most veterinary purposes the B. P. ointment, consisting of sixteen grains iodide to the ounce of lard, is not sufficiently strong, and a more effective preparation is made by mixing one part iodide with eight of lard. Mr William Dollar, of New Bond Street, assures me that one part iodide, dissolved in a water bath in ten of vaselin, makes an equally efficacious ointment, which has the further advantage, even when long kept, of neither changing colour nor becoming rancid. This "**red ointment**" is very effectual for **condensing** and **reducing** splints, spavins, ring-bones, and other **bony deposits.** It penetrates deeply, arrests chronic inflammation, and develops

healthy action in chronic enlargements and indurations of strained tendons, bursæ, and joints. It is occasionally used as a **counter-irritant** in sore throat, chronic cough, and roaring, relieving cases that have resisted milder blisters. When effusion has occurred in pneumonia in horses, and other irritants are ineffectual, an ounce of iodide ointment, rubbed (if need be) into each side, is stated sometimes to give relief. It is frequently applied with advantage to the rheumatic joints of cattle. Repeated dressings are serviceable in arresting induration of the absorbent glands and vessels in the earlier stages of **farcy**; and in such cases it is more reliable than mercurial or citrine ointments, sometimes substituted for it. When absorbent and counter-irritant effects are to be produced, it is sometimes used diluted with iodine ointment. The strong red iodide ointments require to be used with care, otherwise they may destroy the hair-roots, cause sloughing and blemishing, and produce constitutional effects.

MERCURIC NITRATE. Mercury Nitrate. $2Hg\ (NO_3.)_2$

UNGUENTUM Hydrargyri Nitratis. Citrine Ointment.

When mercury is dissolved in diluted nitric acid, and the solution boiled gently for fifteen minutes, there is produced the B. P. **liquor hydrargyri nitratis acidus**—a colourless, strongly acid, caustic solution.

The **unguentum hydrargyri nitratis,** or citrine ointment—the pharmaceutical imitation of the empirical Golden Eye Ointment—is prepared by mixing a hot solution of mercury in nitric acid with lard or olive oil. It has a lemon-yellow colour, a nitrous acid odour, and is apt to spoil unless well made, and kept in earthenware vessels secluded from light.

ACTIONS AND USES.—The stronger mercuric nitrate solutions are caustics, applied for many of the purposes for which corrosive sublimate is serviceable, and useful in canker in the feet of horses and foot-rot in sheep. Milder solutions and citrine ointment are good remedies for eczema, especially after heat and pain have been subdued and desquamation has set in, and are usefully alternated with tar preparations. Along with good feeding and alkaline washes, they are applied in

those cases of pityriasis not uncommon amongst cattle in poor condition. They destroy lice and other skin parasites, and the cryptogamic growths of contagious ringworm. Being easily absorbed, if too freely applied they induce the usual specific effects of mercury. Diluted with olive or almond oil or lard, citrine ointment relieves irritable swollen discharging conditions of the eyelids.

MUSTARD.

SINAPIS. A mixture of the powdered seeds of white mustard —Brassica or Sinapis alba; and of black mustard—Brassica or Sinapis nigra. *Nat. Ord.*—Cruciferæ.

The Brassicæ or Sinapes are annuals one to two feet high, with yellow cruciform flowers, and pods containing several brown seeds. They are indigenous in most parts of Europe, and extensively cultivated in Durham, Yorkshire, and Lincolnshire. An abundant wild variety, familiarly known as charlock and kellocks, is sometimes used for adulterating the better sorts. The **black mustard** seeds are red or greyish-brown, about the size of millet; the greenish-yellow powder has a pungent oily taste, and when triturated with water exhales the pungent irritant volatile oil of mustard. The **white mustard** seeds are double the size of the black, lighter in colour, and when triturated also produce a pungent yellow oily emulsion.

The **mustard-flour** of the shops is generally made as follows:—"Two bushels of black and three of white seed yield, when ground, 145 lbs. of flour; which, to diminish the pungency and improve the colour, is mixed with 56 lbs. wheat flour and 2 lbs. turmeric; and the acrimony is restored, without the pungency, by the addition of 1 lb. Chili pods and $\frac{1}{2}$ lb. ginger. Black seed alone, it is stated, would be much too pungent for use at table. Wild mustard seed is sometimes substituted for the black species if the latter be scarce. Some manufacturers remove the fixed oil from both the white and black seed by means of expression, before making them into mustard-flour with the other ingredients, and the acrimony of the product is thus increased" (*Christison's Dispensatory*).

Both black and white mustard seeds contain about 25 per cent. of a yellow, tasteless, non-drying fixed oil, similâr to that of rape, and consisting of olein, stearin, and glyceride of erucic or brassic acid ; 20 per cent. of mucilage, chiefly found in the epidermis; 4 of inorganic matters ; and 10 to 15 of **myrosin,** a ferment similar to diastase or the emulsin of bitter almonds, usually more abundant in white than in black mustard seeds, and coagulated, and rendered inactive when heated above 140° F. Black mustard, besides, contains about $2\frac{1}{3}$ per cent. of the crystalline **potassium myronate** or sinigrin ; white mustard contains an allied principle, sinalbin. When these bodies are dissolved in water, as in mixing mustard-flour into paste, they are decomposed by the fermentescible myrosin, and there are produced two pungent, acrid, irritant oils—the **volatile oil of mustard** ($H_5 C_3 NCS$) from the black mustard, and the oily vesicating acrinyl sulphocyanate ($C_8 H_7 NSO$) from the white mustard (*Flückiger and Hanbury*). The oil of mustard, regarded as allyl isosulphocyanate, is thus formed from potassium myronate :—

$$\underset{\text{Potassium Myronate.}}{KC_{10} H_{18} NS_2 O_{10}} = \underset{\text{Glucose.}}{C_6 H_{12} O_6} + \underset{\text{Potassium Bisulphate.}}{KH\ SO_4} + \underset{\text{Mustard Oil.}}{H_5 C_3 NCS}$$

Actions and Uses.—Unbruised mustard-seeds, being only partially and gradually digested, have little effect when swallowed. When the ground seeds are mixed with water, the pungent acrid oils are evolved ; large doses of the flour are accordingly **irritant,** medicinal doses are **stomachic, carminative,** and **stimulant.** It is, however, rarely used internally, excepting as **an emetic** for the dog, cat, or pig. For this purpose a dessert-spoonful of mustard-flour is given dissolved in several ounces of water. It is **slightly laxative and diuretic.**

As an external irritant, mustard is much used as a **rubefacient, vesicant, and suppurant.** The paste made with water, and rubbed into the skin of the horse, within fifteen minutes causes redness, heat, and tenderness. By reflex action, the activity of conterminous and subjacent parts is roused (p. 65). Applied in larger quantity, or with smarter friction, the epidermis, after three or four hours, is separated from the true skin by effusion of serum, the small vesicles run

into considerable blebs, which subsequently break and suppurate; surrounding parts are swollen. The skin generally heals in a week. Occasionally, however, from repeated, prolonged, or injudicious use in irritable states of the skin, there ensue active inflammation, sloughing, and destruction of the hair-roots. Such severe effects are unjustifiable.

In the treatment of pneumonia and other internal inflammation, Professor Williams declares that the good results generally ascribed to mustard are more effectually and safely secured by the use of hot fomentations. In the horse, he says, "the application of either mustard or turpentine causes very great distress, a high state of excitement, increase of the febrile disturbance, and often tends to hasten a fatal termination" (*Principles and Practice of Veterinary Surgery*). Such injurious effects seldom, however, result when mustard is carefully and discriminately used. The occasional abuse of a useful medicine should not necessitate its disuse.

Compared with cantharides, mustard is more prompt, but less permanent; it is used to control functional disturbance rather than to repair structural damage; it causes less exudation of serum, but more swelling of surrounding parts; applied repeatedly, especially to the extremities of the horse, it is more apt to affect the skin deeply, and hence produce sloughing; unlike cantharides, it has no tendency to act upon the kidneys. It is almost as prompt, and is more manageable than very hot water. For horses, it is less irritating and burning than oil of turpentine. It is not so severe or so apt to cause suppuration as euphorbium or croton oil. For cattle, mustard is an excellent blister, often acting promptly on their thick and insensible hides when other agents have slight or tardy effect, and seldom causing injury or blemishing. For sheep and dogs it is also useful, especially when applied, as it ever should be, in moderate amount, and for a short period.

MEDICINAL USES.—In all veterinary patients suffering from catarrh, sore throat, laryngitis, bronchitis, pneumonia, and pleurisy, mustard, applied in the early congestive stage, **lessens pain** and **relieves difficult breathing.** It is more serviceable in chronic than acute bronchitis. It often answers well where the inflammation affects the lesser bronchi, and

where there is considerable exudation. In pleurisy, weak mustard liniments alternated with fomentations are often applied at intervals throughout the attack, but are specially indicated after the tenth day, when such counter-irritation contributes to absorption of exudate. During the hepatisation stage of pneumonia mustard is of little use; but, after five or six days, occasional dressings are again serviceable in sustaining the action of the heart and promoting absorption. It is most effectual when rubbed over a considerable area immediately external to the congested, painful, or inflamed parts; after about fifteen minutes, washed off; and in an hour or two, if required, again re-applied.

In acute indigestion, colic and enteritis, especially amongst horses, repeated dressings help to control irregular, violent nervous action. In phlebitis a smart blister reduces inflammation, and hastens absorption of exudate. Mustard is of service in chronic rheumatism, especially amongst cattle; in the second stages of inflammation of joints and tendons; in enlargements of glands; and occasionally as a stimulant in chronic scurfy skin diseases. Flying blisters, applied over the chest or abdomen, or below the knees and houghs, especially when the limbs are cold, arouse vitality and overcome congestion in the later stages of pneumonia, in parturient apoplexy of cattle, and in poisoning by narcotics. With stimulants administered internally, it is rubbed over the region of the heart to counteract syncope. Applied over the kidneys, it promotes diuresis. It is occasionally used for determining secretion of pus, for maintaining or increasing the effects of cantharides; but in horses considerable caution is necessary in applying the one irritant soon after the other.

Mustard is **specially indicated** where extensive counter-irritation has to be speedily produced and stimulation of the kidneys is to be avoided. It is superseded by more permanent vesicants, such as cantharides or mercuric iodide ointment in chronic diseases of joints, and where structural changes have occurred in bone, cartilage, or tendon. Neither mustard, nor indeed any blisters, can be directly applied to parts extensively or deeply inflamed without increasing dangerous destructive metamorphosis and causing sloughing.

Doses, etc.—If used as a stomachic, carminative, or mild stimulant, horses take ʒ iv. to ʒ vj.; cattle, ℥ ss. to ℥ j.; sheep and pigs, ʒ j. to ʒ ij.; dogs, grs. x. to grs. xx. To prevent irritation of the fauces, it is given in the form of pill or electuary. Larger doses, especially in solution, act as emetics in dogs, cats and pigs.

Externally it is used generally as **a paste** made as for table purposes, with water, which should be tepid, but not hot. Extra activity is secured by using black and white mustard seeds, in about equal amount, ground unmixed with bland ingredients, or by adding to the paste made from the mustard of the shops a little oil of turpentine or ammonia. Spirits and vinegar, sometimes advised as solvents, retard formation of the active vesicating oils. A paste made with water alone produced, in six minutes, effects similar to those which it required fifty minutes to produce with the same mustard made up with vinegar. The paste freshly-made with water is usually applied directly to the skin, with smart friction; after fifteen or twenty minutes it is washed off with tepid water, and may be again applied, if required, three or four times. Such repeated moderate external warming is usually more serviceable than one violent irritant dressing, whether for diminution of congestion, relief of pain, or even for removal of exudate. Unwarrantable, topical, as well as general irritation, as already indicated, is occasionally produced, especially in nervous horses, by the free and continued use of mustard. Wasteful, painful discharges from severely-blistered surfaces seldom serve any good purpose, but, on the contrary, often hinders repair or cure.

For veterinary patients, little use is made of **plasters** prepared by spreading mustard upon calico or paper; of **leaves** used in human practice, and consisting of powdered mustard seeds and gutta-percha solution spread upon cartridge paper and dried; or of **poultices** usually made with equal parts of mustard and linseed-meal, well stirred with four parts of hot water.

A tincture of the essence of mustard, in the form of **Savary's liquid Sinapism** has been used **hypodermically** in France as a counter-irritant. In chest affections, 15 to 30

drops are injected at three or four points on each side of the body. The resulting œdema appears within ten minutes, but is said to be less painful, and to cause the patient less disturbance than mustard in the usual form. No untoward local or general effects are observed. Such injections have also been used in the neck, in vertigo, and ophthalmia; under the belly in the gastro-intestinal forms of influenza, and also in colic, enteritis, and umbilical hernia (*Journal of Comparative Pathology and Therapeutics,* March 1888).

Volatile oil of mustard, got by distilling black mustard seeds with water, is one of the most poisonous of the volatile oils. Rabbits are killed in two hours by a drachm, in fifteen minutes by half an ounce, with symptoms of gastro-enteritis, loss of sensation and muscular power, difficult breathing, and collapse. Applied externally it is a prompt and powerful vesicant.

MYRRH.

MYRRHA. A gum-resinous exudation from the stem of Balsamodendron Myrrha.—(B. P.) *Nat. Ord.*—Burseraceæ or Amyridaceæ.

Myrrh is imported from the coasts of the Red Sea. It has long been used with olibanum or frankincense in making incense, perfumes, holy oils, and unguents for embalming. It occurs chiefly in the cortical layer of the trunk or branches of probably more than one species of shrubby thorn-like Balsamodendrons. As it exudes spontaneously from perforations or cracks, it is a yellow-white oily substance, which as it dries becomes a brown-red gum-resin. The best sorts are in irregular-shaped, semi-translucent, red-brown tears, or masses of tears, which deepen in colour when breathed on. They are brittle, and easily powdered; their fracture is irregular, shining, oily, and occasionally dotted with opaque white markings. Myrrh has a slightly bitter, acrid taste, and an agreeable, aromatic odour. When heated, it softens, froths up, and burns, leaving a dark spongy ash. Powdered with water it forms an emulsion, but readily dissolves in rectified spirit. It consists of 50 to 60 per cent. of soluble gum, chiefly arabin; 30 to 40 of a resin.

termed myrrhus, (C_{48} H_{32} O_{10}), soluble in alcohol, ether, and acetic acid, and with prolonged heat losing O_2, and being converted into myrrhic acid; and two per cent. of a pale-yellow volatile oil, myrrhol (C_{10} H_{14} O) isomeric with thymol.

Actions and Uses.—Myrrh is a bitter stomachic, feeble tonic, and stimulant; externally, it is stimulant and astringent. It is similar to the fragrant gum resin olibanum, produced by several species of Boswellia; and to the concrete resin of the Elemi tree imported from Manilla. It differs from the turpentines and balsams in possessing slight tonic properties; it is less stimulant and antispasmodic than the fœtid gum resins of the Umbelliferæ. It is occasionally prescribed in atonic indigestion, and to abate excessive secretion in chronic catarrh, and other mucous discharges; and as a stimulant and antiseptic vulnerary.

Doses, etc.—Horses and cattle take ʒ ij.; sheep and pigs, ʒ ss. to ʒ i.; dogs, grs. x. to grs. xx.; repeated several times daily, in bolus, decoction, or tincture, used with other tonics, or with aloes, sometimes in the form of the compound tincture of aloes and myrrh, which is thus prepared:—Macerate one ounce each of myrrh and aloes, coarsely powdered, in a mixture of methylated spirit f℥ xiv., and water f℥ vi., for fourteen days in a closed vessel; shake frequently, filter, and add proof spirit to make one pint.

NUX VOMICA.

Nuces Vomicæ. The seeds of Strychnos Nux Vomica. *Nat. Ord.*—Loganaceæ.

Strychnine. Strychnia. An alkaloid prepared from Nux vomica, from the Strychnos Nux vomica or false Angustura bark, from St Ignatius' bean, and occurring in other plants of the natural order Loganaceæ.

The Strychnos Nux vomica grows on the southern coasts of India, in many islands of the Indian Archipelago, and in the northern parts of Australia. It is a moderate sized tree, with crooked stem, irregular branches, tough white wood, known in commerce as snake-wood; grey or yellow bark—the poisonous

false Angustura bark; a globular berry, about the size of an apple, containing, amid a soft gelatinous pulp, which birds are said to eat with impunity, five round, flat, yellow-grey seeds, about an inch in diameter. These seeds have a central scar or hilum on one surface, are covered with short satiny hairs, have an intensely bitter taste, and are tough, horny, and require to be steamed and dried before they can be powdered. Nux vomica **contains** albumin compounds, sugar mucilage and fat; the soluble amorphous **strychnic** or **igasuric acid**, which is allied to malic acid; and two poisonous alkaloids—**strychnine** and **brucine**—each present to the amount of about one per cent.

Strychnine ($C_{21}H_{22}O_2N_2$) is prepared by splitting the nux vomica seeds, steaming and reducing them to powder, which is digested with spirit and water. The spirit is recovered by distillation. To the watery extract lead acetate is added, which precipitates acid and colouring matters. The filtered solution is treated with ammonia, which precipitates the alkaloids. The precipitate is washed, dried, and re-dissolved in spirit, and the solution reduced by evaporation, set aside, when the less soluble strychnine crystallises out, leaving brucine in solution. Commercial strychnine usually contains brucine; but repeated washing with diluted spirit, boiling with rectified spirit, and crystallising, secure the pure alkaloid (*B.P.*)

Strychnine occurs in four-sided or octahedral right rhombic prisms, is colourless and inodorous; it requires for solution, 7000 parts of cold water, and 2500 parts of hot water, but its intensely bitter taste is appreciable even when diluted with 1,000,000 parts of water. It is soluble in boiling rectified spirit, and in chloroform, but not in absolute alcohol or in ether. It is not coloured by nitric acid, and leaves no ash when burned with free access of air. It forms crystalline, colourless, intensely bitter salts.

It is **readily recognised.** On a white plate, a crystal is dissolved in pure sulphuric acid without change of colour, but when the dissolved alkaloid is made to mingle with a drop or two of an oxidising solution, such as that of potassium bichromate, there is produced a characteristic **play of colours,** including blue, purple, crimson, and red-brown, which fades to a light red, remaining permanent for several hours. No other

substance exhibits these colour changes. The **extreme bitterness** and the **tetanic spasms** produced in frogs and other small animals by solutions containing the $\frac{1}{5000}$th part of a grain, are valuable corroborative tests.

Brucine or Brucia ($C_{23}H_{26}N_2O_4.4H_2O$) is associated with strychnine in the seeds, and still more largely in the nux vomica bark and St Ignatius' bean. It crystallises from the mother-liquor from which strychnine has been separated; occurs in oblique four-sided prisms; is almost as bitter, but is more soluble in water than strychnine. It is reddened by nitric acid and chlorine. The bright red coloration caused by nitric acid is changed to violet or green by sodium hyposulphite and other reducing agents, which decolorise the analogous red coloration produced by the action of nitric acid on morphine. Strong sulphuric acid colours brucine a rich rose tint, but on adding oxidising agents such as potassium bichromate or manganese black oxide, no play of colours is observed, as occurs with strychnine.

Actions and Uses.—Nux vomica, strychnine, and brucine are stimulants of the motor centres of the spinal cord, and of other motor centres. Full doses produce tetanic convulsions, which cause death from asphyxia, or from subsequent paralysis and exhaustion. Medicinal doses are gastric, vascular, and nerve tonics, and antiparalysants. They destroy enzymes and other low vegetable and animal organisms.

General Actions.—The alkaloids differ from each other and from nux vomica only in the degree of their action. Strychnine is upwards of fifty times as active as the powdered nux, and more than twelve times as active as brucine. The St Ignatius' bean yielded by the Strychnos Ignacia—a tree grown in the Philippine Islands—contains strychnine and brucine. Akazga, the ordeal plant of the West Coast of Africa, belongs to this order, and yields akazgine, which is analogous to strychnine. Other trees of the order also yield tetanising poisons. Allied to this group of spinal stimulants are thebaïne and some other opium alkaloids; gelsemine, the alkaloid obtained from the rhizome and rootlets of yellow jasmine; and picrotoxin, a neutral principle prepared from the seeds of Anamirta paniculata. The methyl compounds of strychnine and brucine, instead

of stimulating spinal and motor centres, and producing convulsions, resemble curare, and paralyse the ends of motor nerves.

Strychnine, which may be taken as representing both brucine and nux vomica, lessens oxidation of protoplasm and of blood, and checks fermentation, but not nearly so effectually as quinine. Low organisms wetted with weak watery solutions have their activity increased; wetted with strong solutions, their activity is diminished and they are destroyed. It **stimulates the grey matter of the spinal cord,** exalting its reflex excitability, and also stimulates **other reflex nerve centres.** Its bitter taste promotes secretion of saliva and increases gastro-intestinal movements, improves appetite, and assists in overcoming constipation. Repeated doses increase sensory sensibility. Large doses cause muscular twitchings and clonic convulsions. The extensor usually overcome the flexor muscles, producing opisthotonos. **Death results from asphyxia,** occurring during a spasm, or from paralysis and collapse, occurring during a period of relaxation. It increases blood-pressure, stimulates the motor ganglia of the heart, and also the respiratory centre. Indirectly, the muscles are exhausted from the violent convulsions. From stimulation of the centres, the sensory nerves become acutely sensitive to impressions *(Brunton).* Strychnine is **absorbed** more rapidly from the rectum than from the stomach, and still more rapidly from the bronchi and cellular tissues. It has been detected in the blood, the spinal cord, and the brain. It appears to be **excreted** unchanged in the urine, in which it has been found an hour after administration, and has been detected forty-eight hours later.

Toxic Effects.—Poisonous doses produce in all animals trembling and twitching of voluntary, and also of involuntary, muscles, and violent clonic spasms, usually lasting one to two minutes, gradually becoming more frequent and severe; and from their involving the glotis, diaphragm, and other muscles of respiration, causing death usually by asphyxia. The symptoms and mode of death **resemble** those of **tetanus,** but are more suddenly developed, more intermittent, and more rapidly fatal. The muscular rigidity does not, as in tetanus, first affect the muscles of the jaws, and the spasms are clonic, while in tetanus they are tonic.

The several classes of **animals differ in** their **susceptibility** to the actions of strychnine. Horses and cattle are not so readily affected as men and dogs. Poultry are said to be less easily affected than other birds ; while guinea-pigs and some monkeys seem almost entirely to resist its action, at least so long as it is given by the mouth (*Dr H. C. Wood, Treatise on Therapeutics*).

Horses had twitching of the muscles after swallowing 6 grains of strychnine, and were poisoned by 12 grains in about twelve minutes (*Tabourin*). Five grains in bolus produced, after six hours, abdominal pain, laboured breathing, acceleration of the pulse from 42 to 60, starting when touched, and tetanic spasms. Twelve hours later the pulse was 96, and subsequently rose to 120. Blood-letting and fomentations gave no relief, and in a convulsive paroxysm the horse died. The membranes of the brain and cord were injected, the lungs engorged (*Veterinarian*, March 1856). Half a grain, given hypodermically, induced in half an hour general muscular rigidity. Hertwig gave a horse **nux vomica** ʒx. in powder, with the effect of causing muscular tremors; but this dose in solution proved fatal in ten hours. Professor Coleman gave a mare ℥ij. in a drench ; within an hour, and after the animal had drunk some water, she had violent tetanic symptoms, and died half an hour later. Ounce-doses, given a glandered horse, caused tetanic spasms, but were not fatal. Moiroud states that the fatal dose for a horse is one to two ounces.

Cattle stand larger doses than horses, even when the poison is given in solution. Mr MacGillivary, Banff, gave an old cow 30 grains strychnine, and shortly after 60 grains, both doses in solution, with the result of a few spasmodic tremors, which continued for about twenty minutes (*Veterinarian*, November 1870). But 4 grains placed in the areolar textures of a cow, destroyed it in twenty minutes (*Tabourin*). I gave a small red cow, affected with pleuro-pneumonia, grs. xv. strychnine, suspended in two ounces of oil, at 12 o'clock. At 12.30 the pulse had risen from 70 to 78, regurgitation was observable in the jugular veins, quivering and twitching affected the facial muscles, particularly during inspiration. At 12.45 the pulse numbered 84, and the symptoms were aggravated. Grs. ij. were given,

dissolved in diluted acetic acid ; and in a quarter of an hour the animal was very uneasy, and attempted to vomit ; the pulse was 94, full and strong, the pupils much dilated. At 1.30 the nausea and efforts to vomit were much increased, the breathing more laboured ; the animal lay down and the pulse shortly fell to 58. At 2.15 the nausea was diminished, and the pulse 92. Grs. xxx. were then given in acetic acid and water. At 2.20 the pulse was 100, sharp and distinct. The muscles were affected by frequent spasms. At 2.25 the pulse was 140, and the animal shewed much sensitiveness, especially about the hind extremities. It reeled and fell. At 2.30 the pulse had risen to 160, the limbs were very rigid, the eyes protruding, the involuntary spasms more general, frequent, and severe. Two minutes later she died quietly.

Sheep are destroyed by ℥ss. nux vomica in about thirty minutes, but goats are greatly less susceptible. Tabourin has produced violent convulsions in **pigs** with grs. l.

Dogs are destroyed in two minutes by gr. $\frac{1}{6}$ strychnine, and in twelve minutes by gr. $\frac{1}{8}$ (*Christison*). An English terrier was poisoned in twenty-four minutes by gr. $\frac{1}{2}$; a greyhound in $1\frac{1}{2}$ hours by grs. iij. ; another greyhound in thirty-three minutes by gr. ss. (*Dr S. Macadam*). Professor Christison poisoned dogs with grs. viij. of nux vomica, and cats with grs. v. Dogs poisoned moan and whine, are uneasy, nauseated, sometimes vomit, tremble, have muscular twitchings and general spasms, during which the head is drawn upwards and backwards, and the temperature is raised 4° to 6° F. The tetanic convulsions continue one to two minutes, cease for several minutes, but recur with increased force until death results.

The **post-mortem** appearances vary somewhat with the severity and duration of the case. The asphyxia renders the blood dark-coloured and unusually fluid ; there is generally venous engorgement ; congestion of the lungs and of the cerebral and spinal meninges ; dilatation of the vessels of the medulla, and sanguineous extravasation into the grey matter. When the patient has survived for several hours, the intestines occasionally present patches of redness and congestion. Where the spasms have been severe and rapidly fatal, the left side of the heart is firmly contracted, and contains little if any blood.

The tetanised muscles quickly undergo rigor mortis, which sometimes continues longer than usual. In dogs destroyed with strychnine gr. $\frac{1}{5}$, I found the buccal mucous membrane blanched, the left auricle, as also the intestines, continued to contract for nearly an hour after death, while the cerebral and intestinal vessels were congested with dark venous blood.

ANTIDOTES.—The stomach should be emptied with as little delay as possible; if convulsions have begun, the patient should be anæsthised, the stomach well washed out, and chloral hydrate given hypodermically. Professor Hughes Bennett first shewed the antidotal power of chloral hydrate. He found that the minimum fatal dose of strychnine for rabbits was $\frac{1}{288}$ gr. per lb. of body-weight. Twenty rabbits received more than this poisonous dose; fifteen of these, to whom chloral was given, recovered. But a few days later, on receiving the dose previously given, without the chloral, all died. The strychnine tetanus is also antagonised, although less effectually, by such motor paralysers as curare, conium, tobacco, opium, and calabar bean.

MEDICINAL USES.—As **bitter tonics,** nux vomica and strychnine are prescribed in atonic dyspepsia. Their good effects probably depend upon their checking irregular fermentation, diminishing excessive secretion, as in catarrhal conditions, and perfecting co-ordination between the several functions of digestion and assimilation (*Brunton*). It is probably mainly in this way that they relieve many cases of broken-wind.

Small doses, especially when combined with acids, are often effectual in checking chronic **relaxed conditions of the bowels,** where these are not complicated with irritation. Larger doses, increasing peristalsis, overcome **chronic constipation,** whether connected with acute indigestion, inflammation, or febrile attacks, and are usually prescribed with aloes or salines. They **give tone** in weak dilated conditions of the heart; during their excretion exert tonic action on the urinary organs, and aphrodisiac effects are occasionally produced. In convalescence from acute disease, they improve appetite and general tone.

The marked stimulant action of these nerve-tonics on the motor centres of the cord, and on motor centres generally, in-

dicate their use in **paralysis** when unaccompanied by irritation or congestion, and whether exhibiting impaired action of the limbs, the intestines, or bladder. They are most beneficial in chronic functional cases. They often relieve paralysis depending on falls or other injuries, on lead-poisoning, or as sequels of influenza, stomach-staggers, or rheumatism. Brown Séquard, moreover, believes that even where paraplegia results from softening or wasting of nervous textures, degeneration may be arrested by strychnine dilating the capillaries, determining a fuller current of blood, and promoting nutrition. In paralysis of those muscles of the larynx constituting roaring, Mr F. Mavor, Park Street, London, injected strychnine subcutaneously, and found the treatment successful in the earlier stages, and before wasting of the muscle had occurred. French veterinarians prescribe it in amaurosis.

Probably from climatic peculiarities, **cerebro-spinal meningitis** is greatly more common amongst horses in America than in Great Britain. Often it occurs as an epizootic. Mr Alexander Lockhart, of New York informs me that he has seen two hundred horses affected at the same period in one tram-car stud, and has had eighty patients in slings at one time. It attacks horses of all sorts, and under every description of management. Blood-letting and physic, he believes, hasten and increase mortality ; under such reducing treatment half the cases die. It is unsafe to give more than half a dose of physic ; oil is preferred to aloes. Although the cerebral form is very hopeless, Mr Lockhart assures me that 95 per cent. of the patients able to stand recover if at once treated with a grain of strychnine repeated twice or thrice a day. In these cases Professor Robertson recommended Easton's syrup (p. 422).

In cattle practice, nux vomica and its alkaloids are used especially in chronic paralysis. The late Mr David Aitken, Loughborough, who prescribed them with success since 1853, informed me of several typical cases. Two bullocks suffered from **chronic paralysis**—one so entirely that it had to be carted home from the grass field. He was dull ; his pulse 55, and rather weak ; his hind extremities and tail had lost their power of movement, their sensation was impaired ; the sphincter

ani was relaxed, and both fæces and urine were passed involuntarily. Purgative medicine was given, and operated next day, without, however, any abatement of the paralysis. Two drachms nux vomica were prescribed night and morning for ten days; but little improvement being notable, the dose was increased to three drachms thrice a day. This treatment being persisted with for ten days, the patient was able to walk round the house in which he was confined, and rapidly recovered. The other bullock exhibited similar symptoms, was treated in the same manner, and with like satisfactory results.

A week or two before parturition, cows, especially if in low condition, occasionally lose the power of their hind limbs, and are unable to stand. Little can then be done besides allowing laxative nutritive diet, with tonic medicine, and turning the patient several times daily. Most of these cases, within two or three days after parturition, gradually regain the use of their limbs; but when **defective nervous power** continues, nux vomica or strychnine is used with success.

Similar treatment has also been employed in puerperal apoplexy, but in the cerebral and most fatal form of this disease, there is too much acute congestion to justify the use of such active nerve stimulants.

In canine practice, strychnine is a valuable tonic in atonic indigestion, in convalescence from exhausting disease, in chorea, and in paralysis resulting from distemper or other causes. In many of these cases it is conjoined or alternated with iron salts, or used in the form of Easton's syrup.

Strychnine is used for the destruction of rats, mice, and other vermin, and for the poisoning of wolves and other wild animals. It constitutes the active ingredient of various "infallible" insect and vermin destroyers, which are usually made up with starch, sugar, and about 10 per cent. of strychnine.

DOSES, ETC.—Of the powdered **nux vomica,** horses take ʒss. to ʒj.; cattle ʒi. to ʒij.; sheep, grs. x. to grs. xl.; pigs, grs. x. to grs. xx.; dogs, gr. ss. to gr. ij. The powder has the disadvantage of not being very soluble. The extract is eight or ten times as active as the powder. A tincture is sometimes used.

Strychnine is more uniform and more readily absorbed than the crude drug, and is upwards of fifty times more powerful. The hydrochlorate, on account of its solubility, is preferable to the alkaloid. The dose for the horse is gr. i. to grs ij.; for cattle, grs. ij. to grs. v.; for sheep, gr. $\frac{1}{5}$ to gr. i.; for dogs, gr. $\frac{1}{50}$ to gr. $\frac{1}{20}$.

Nux vomica and strychnine are generally given twice a day; and as antiparalysants, the doses may be cautiously and gradually increased, until slight muscular twitchings are produced. When given by other channels than the mouth, they must be used in considerably smaller doses. When injected into any of the hollow organs, or especially when strychnine is used hypodermically or intravenously, the dose should not at first exceed one-fourth part of that which can be safely given by the mouth. For hypodermic purposes, 1 part of strychnine hydrochlorate is dissolved in about 100 parts of a mixture of rectified spirit and water. **Strychnine arsenite** has been recommended in some of the continental veterinary schools for the treatment of persistent nasal discharges.

OAK BARK.

QUERCUS CORTEX. The dried bark of the smaller branches and young stems of Quercus Robur (Q. pedunculata). Collected in early spring from trees growing in Britain. (B. P.) *Nat. Ord.*—Cupuliferæ.

Bark from smaller branches or young trees is more astringent than thicker pieces of older growth; the interior finer fibrous portions than the external rougher cortical. Oak bark contains a bitter crystalline substance, **quercin,** and owes its astringency to 10 to 15 per cent. of **querci-tannic** acid, which differs somewhat from gallo-tannic acid, and does not, by oxidation, yield gallic acid. The infusion has a powerful astringent taste, reddens litmus, gives a blue-black precipitate with ferric salts; and with gelatin solution a white flocculent precipitate, which resists putrefaction better than that of gallo-tannic acid. **Acorns**—the fruit of the oak—are collected in many parts of England for feeding sheep and pigs, are con-

sidered nearly as valuable as beans, but on account of their astringency require to be used sparingly.

ACTIONS AND USES.—Oak bark is **astringent,** resembling galls and catechu. It is prescribed to check chronic diarrhœa, dysentery, and other excessive mucous discharges. For weakly scouring calves, the decoction is given once or twice daily as required, either alone or with gentian, spirit, ether, or chloroform, or, where there is griping, with laudanum. It lacks the tonic properties of cinchona and gentian, and when given too frequently or freely, causes intestinal derangement. A decoction is applied for stimulating unhealthy wounds, bracing relaxed mucous membranes, and relieving piles in dogs.

DOSES, ETC.—Horses take ʒij. to ʒiv.; cattle, ℥ss. to ℥ij.; sheep and pigs, ʒss. to ʒij.; dogs, grs. x. to grs. xxx.; administered in infusion or decoction, made with one or two ounces of oak bark to the pint of water. It is given with aromatics and bitters; in dysentery, with opium and starch gruel; in typhoid cases, with camphor and mineral acids.

OLIVE OIL.

OLEUM OLIVÆ. The oil expressed from the ripe fruit of Olea europæa. (B. P.) *Nat. Ord.*—Oleaceæ.

Several varieties of the evergreen Olea europæa, grow abundantly in the countries bordering the Levant and Mediterranean; from the stem a resinous juice once used in medicine can be got; the leaves are bitter astringent and tonic; the olives are oval succulent purple drupes about the size of damsons and containing a single seed. The ripe pulp or pericarp yields about 70 per cent. of oil, of which the finest, imported from Provence and Florence, is obtained by moderate pressure of the freshly-gathered fruit placed in coarse bags. Medium qualities are prepared by strong pressure from long-gathered and fermented fruit, and a good deal of oil of this description is brought from Naples, Inferior varieties, got from stale or rotting olives, or by moistening with boiling water and pressing the residue left during the manufacture of superior qualities, come from Sicily and Spain. The crushed kernels also yield a small amount of fixed oil (*Flückiger*).

Properties.—Olive oil is one of the fixed fatty or expressed oils, which produce on paper or linen a greasy stain, not removed by heat; and are glycerides of an acidulous radical, oleic, palmitic, or stearic acid, and the basylous glyceryl or propenyl. Olive oil contains about 72 per cent. of fluid olein or tri-olein $C_3H_5(C_{18}H_{33}O_2)_3$, holding in solution about 28 of palmitin and allied fatty matters. It is of the consistence of syrup, unctuous, transparent, odourless, and bland-tasted. When pure it is pale greenish-yellow; when impure, yellow or brown. Its specific gravity, at 77° F. is ·920. At 38° F. its solid fats begin to crystallise; at 32° F. it is completely solidified. It is not miscible with water, is scarcely soluble in alcohol, but dissolves in one and a half of ether. It is a capital solvent for cantharidin, atropine, and morphine. Exposed to air, it oxidises, thickens, and slowly becomes rancid, but does not dry up.

Actions and Uses.—Olive oil is **nutrient, laxative,** and **emollient.** Like other bland oils, small quantities are easily digested and assimilated, aid cell development, and by oxidation support animal heat. Larger quantities, such as one or two pints for horses or cattle, and two or three ounces for dogs, are laxative. An ounce each of olive and castor oil makes a mild laxative for the dog. Like other fluid fats, when injected into the veins, it fatally obstructs capillary circulation. Half-an-ounce injected into the jugular speedily destroys a dog. As a demulcent and emollient it is used in poisoning by irritants and corrosives; it antagonises the action of alkalies by forming soaps; and retards solution and absorption of arsenic. Small doses are occasionally given to horses and other animals, to soothe the irritable mucous membrane in chronic catarrh and bronchitis. Not drying or readily becoming rancid, it is a soothing protective for irritable or abraded surfaces, but for such veterinary purposes is usually superseded by the cheaper rape, lard, or linseed oils, or by vaselin.

OPIUM.

THE JUICE obtained in Asia Minor by incision from the unripe capsules of Papaver somniferum, inspissated by spontaneous evaporation. (B. P.) *Nat. Ord.*—Papaveraceæ.

MORPHINE. Morphia. Morphina. An alkaloid prepared from opium. (B. P.)

MORPHINE HYDROCHLORATE. Morphinæ hydrochloras. (B. P.)

MORPHINE ACETATE. Morphinæ acetas. (B. P.)

Opium, one of the most ancient articles of the Materia Medica, derives its name from the Greek word ὀπός (*opos*), signifying juice. The stem, unripe capsules, and other succulent parts of any species of poppy contain a milk-white narcotic juice, which, as it dries, becomes darker in colour and constitutes opium. The fresh red petals of the **Papaver rhœas,** or corn rose, used as colouring agents, when eaten by animals are stated to have caused staggering gait, pain, delirium, and sometimes stupor (*Veterinarian's Vade Mecum*); but this is scarcely possible, as they contain no morphine, and only minute traces of rhœadine. The roots of some species contain a cathartic principle. The nearly ripened **poppy heads** or capsules, gathered about twelve days after the petals fall, are digested in hot water and used for anodyne purposes, when dried they yield less morphine and codeine, than when green, and besides contain the feebly alkaline crystalline rhœadine, and a large amount of mucilage. Within the capsules are numerous white or brown reniform seeds, devoid of narcotism, but yielding a bland, drying oil, similar to that of flax or rape. The cake or residue left after expression of this oil is used as a cattle food.

The Papaver somniferum—the common white or garden poppy—is a native of the warmer parts of Asia, but it also thrives in this country. It flowers from May to July, and the capsules ripen about two months later. It is two to four feet high, has a round, smooth, erect stem, with a few hairs on the extremities and peduncles; large, sessile, glaucous green leaves, with cut and wavy margins; large terminal white, red, or purple flowers, drooping before they open; and globose capsules about the size of a duck's egg, and containing numerous kidney

shaped white or brown seeds. Of the several varieties the white-flowered have hitherto been preferred, but the darker-flowered, especially the purple, are now stated to yield a larger quantity and better quality of opium.

In collecting the juice, transverse or spiral superficial incisions are made towards sunset into the nearly ripened capsules, a few days after the fall of the petals, and when their blue-green colour is changing to golden yellow. There exudes a thick milk-white juice, which concretes and deepens in colour until in twelve or fifteen hours it forms semi-solid, red-brown, adhesive tears. These are collected, formed into larger masses, dried, and packed for exportation in poppy leaves, in the leaves and winged seeds of a species of rumex, or in tobacco leaves and poppy petals. In Persia and India the tears collected from the capsules are rubbed in a mortar, and hence the amygdaloid structure is lost. Upwards of thirty tons of opium are annually consumed in this country.

The several varieties—of which the most notable are Turkey, Egyptian, East Indian, Persian, and European—owe their characteristics to differences in soil and climate, and also to the time and manner of collecting and making up the juice.

TURKEY or SMYRNA OPIUM, mostly of fine quality, and highly prized in the English market, is chiefly collected in the north-western districts of Asia Minor. It occurs in round flattened pieces, usually weighing from half a pound to two pounds; is covered with poppy leaves and the chaffy seeds of the rumex. It is soft, moist, and ductile; and, when minutely examined, is seen to be made up of small tears. Its odour is peculiar, but not disagreeable; its taste, bitter; its recent fracture, pale liver-brown. It readily yields its active principles to water, forming a red-brown solution, and to alcohol of all strengths, forming darker coloured tinctures. Good samples in a fresh state contain an average of 10 per cent. of morphine.

EGYPTIAN OPIUM, being generally grown on moist soils, and collected before the capsules are ripe, is inferior to the best Turkey opium. It is in round flattened cakes, about four inches in diameter, of a red colour, hard, dry, and brittle; is covered with the remains of the leaf of the oriental plane

(Professor Bentley); and contains on an average about 6 per cent. of morphine.

East Indian Opium, chiefly prepared in the central tract of the Ganges, in the districts of Benares and Patna, and in the province of Malwa, is mostly disposed of to the Chinese, who prefer it to Turkey opium, and purchase annually about twelve million pounds at the rate of about 20s. per lb. The juice is extracted in the usual way, the fluid part poured off, the solid residue carefully dried in the shade, and in most districts disposed of by the native cultivator to the government factories, where it is purified, raised to the desired consistence, and encased in poppy, and sometimes in tobacco, leaves. This outer case gradually becomes black, hard, unyielding, of the appearance of a large bullet, and usually contains about 3½ lbs. standard opium, which remains for a long time soft and ductile, and of a dark pitch-like appearance. The best Bengal opium, not intended for exportation, is dried in the sun until it contains only 10 per cent. of water, is moulded into square pieces of two pounds weight, enveloped in oiled Nepaul paper, and packed in wooden boxes. It is firm, dry, of a yellow-brown colour, and nearly equal to Turkey opium in quality and percentage of morphine. (Report of Dr Eatwell, Opium Examiner at the Government Factory at Ghazipur, in *Pharmaceutical Journal*, vol. xi., 1852).

Persian Opium is chiefly forwarded overland to China. The small quantities brought to Europe, are of irregular quality, occur in rounded cones or flat circular cakes, weigh six to ten ounces, the best samples yielding 8 to 10 per cent. of morphine.

European Opium.—Opium has been cultivated in France and Germany, and also Great Baitian. In 1818 Dr Young grew poppies near Edinburgh, and obtained nearly six ounces of excellent opium from a fall of ground, being at the rate of 57½ lbs. per acre. A still more extensive trial was made in 1823 in Buckinghamshire, where twelve acres of poppies were grown with a return of 16 lbs. per acre of opium, which realised the highest price in the London market. From the high price of Turkey opium at that time, and the low value of land and labour, the speculation proved tolerably satisfactory.

Unless, however, returns could be realised like those got in India, where the acreable yield is 30 lbs., the production of opium could not pay in this country. But under favourable circumstances, poppies might be cultivated, and morphine at once extracted.

Properties.—Opium occurs in irregular red-brown or red-black lumps, which weigh from four ounces to two pounds; usually indicate their being made up from agglutinated tears; break with an irregular, moist, chestnut-red fracture; shine when rubbed with the finger; and have a specific gravity of about 3·36, a strong peculiar aromatic odour, and a disagreeable, persistent, bitter taste. Opium recently imported contains 10 to 15 per cent. of water, and is moist and plastic; when long kept, or artificially dried, it is hard, and easily reduced to a brown powder, which is apt, unless carefully preserved, to absorb moisture. Under the microscope it exhibits various crystalline forms. When heated it softens, and at high temperatures burns with a strong, peculiar odour. Cold water dissolves about 60 per cent. of a good dried specimen, and forms a red-brown solution, including most of the active constituents. Rectified spirit dissolves about 80 per cent., and forms a dark-brown tincture, which includes all the active principles. Acids, when strong, disorganise opium; but when diluted, are excellent solvents for it. The watery solution reddens litmus, owing to the presence of meconic and other acids, and is precipitated by vegetable astringents, salts of calcium, lead, copper, and other metals.

Impurities.—As the best Turkey opium usually brings about 18s. per pound, there is great temptation to substitute inferior qualities and add foreign matters. Inferior specimens are distinguished by narrowly examining their consistence, texture, colour, odour, and taste. They are sometimes dry, hard, and resinous, or oleaginous and waxy; their fresh fracture devoid of the characteristic red tint and agreeable aromatic odour; while water and alcohol dissolve them imperfectly. Of the several substances used for adulterating, the most common are starch and molasses, the bruised leaves and chips of the poppy, the juice, pulp, or extract of the prickly pear, and opium from which the morphine has been

extracted. Inorganic matters such as sand, clay, and mud, may be detected by inspection, especially if the specimen be dried. Excess of moisture is discovered by drying a weighed quantity in a water bath, and ascertaining the loss—which should not, even in recent specimens, exceed 15 per cent. Specimens mixed with vegetable extracts, when drawn along a sheet of white paper, make a light-brown continuous mark, while that caused by pure opium is interrupted. But the most certain test of quality or purity is the proportion of morphine: 100 grains of good opium yield 9·5 to 10·5 per cent. of morphine; but picked specimens have produced 22 per cent.

Composition.—Opium is a complex substance. Besides 10 to 15 per cent. of water, it contains 25 of gummy matters, 20 of ill-defined organic substances, 7 of ash, traces of an aromatic volatile oil, and combined chiefly with meconic and sulphuric acids, are variable proportions of several alkaloids, of which the most important are morphine, codeine, and thebaine.

Subjoined is a list of these opium alkaloids, arranged according to their chemical composition:—

Hydrocotarnine,	$C_{12}H_{15}NO_3$	Papaverine,	$C_{21}H_{21}NO_4$
Morphine,	$C_{17}H_{19}NO_3$	Meconidine,	$C_{21}H_{23}NO_4$
Oxymorphine,	$C_{17}H_{19}NO_4$	Laudanosine,	$C_{21}H_{27}NO_4$
Codeine,	$C_{18}H_{21}NO_3$	Cryptopine,	$C_{21}H_{23}NO_5$
Thebaine,	$C_{19}H_{21}NO_3$	Narcotine,	$C_{22}H_{23}NO_7$
Laudanine,	$C_{20}H_{25}NO_4$	Lanthopine,	$C_{23}H_{25}NO_4$
Protopine,	$C_{20}H_{19}NO_5$	Narceine,	$C_{23}H_{29}NO_9$

Some of these alkaloids are natural derivatives of morphine, from which codeine and oxymorphine can also be prepared artificially. Another series, termed codeines, is prepared from morphine by (1) the addition of alcohol radicles. Codethyline is the best known of these; others are got by (2) oxidation; (3) others by dehydration.

Opium alkaloids differ greatly in their action. Morphine is anodyne and hypnotic. Thebaine is stimulant and convulsant, and allied to strychnine. The best known of the others—oxydimorphine, papaverine, codeine, and narcotine — form a series, in which the first resembles the narcotic morphine, and the last the tetanising thebaine.

Morphine and its salts are got by macerating opium in successive portions of water, which dissolve the morphine meconate; calcium chloride is added to the solution; calcium meconate precipitates, and morphine hydrochlorate remains in solution, which, when concentrated, the morphine salt crystallises, is subjected to pressure in flannel or stout calico, thus removing narcotine and colouring matter, and is re-dissolved in hot water, and repeatedly crystallised. By the use of animal charcoal, colouring matter is removed; while to get rid of codeine, ammonia is added to the watery solution, when pure morphine is precipitated.

Morphine crystallises in minute transparent right rhombic prisms, usually arranged in tufts. It has an intensely bitter taste and an alkaline reaction. It is soluble in ether, benzole, and chloroform; dissolves in 1000 times its weight of cold water, in 400 of boiling water, and still more readily in oils, caustic alkalies, and weak acids, with which it forms crystallisable and usually soluble salts. With a neutral solution of ferric chloride, it produces a purple-blue solution, which gradually becomes green; with nitric acid, an orange-red solution; with iodic acid, a red-brown liquid containing free iodine. Warmed with strong sulphuric acid and a little sodium arsenate, a blue-green tinge is produced.

Morphine hydrochlorate ($C_{17}H_{19}NO_3 . HCl . 3H_2O$) is preferable to the alkaloid on account of its solubility, is the salt in most common use, and is prepared by diffusing the morphine (obtained as above) in hot distilled water, gradually adding hydrochloric acid, and setting aside the solution to crystallise. It is a snow-white powder, consisting of broken-down crystals, which, when entire, are needle-like prisms clustering in radiated groups. It is without odour, but has the intensely bitter taste of morphine. It is soluble in its own weight of water at 212° F., in 24 parts at 50° F., and still more so in spirit.

Morphine acetate and sulphate are sometimes used, and are prepared in a similar manner to the hydrochlorate. The acetate is a white powder almost entirely soluble in 2½ parts of water at 50° F., and readily soluble in spirit.

Apomorphine ($C_{17}H_{17}NO_2$) is prepared by heating morphine and concentrated hydrochloric acid for several hours in a

hermetically closed tube, when an atom of water is abstracted. Dr Lauder Brunton suggests that morphine, by long keeping, may spontaneously undergo this change. It is amorphous, slightly bitter, moderately soluble in water, more so in alcohol; exposed to the air, it gradually becomes green. Apomorphine is a prompt and effectual **emetic** in animals that vomit, acting both reflexly and directly. When gr. $\frac{1}{4}$, dissolved in water, is swallowed either by men or dogs, repeated vomiting occurs, but is not followed by so much nausea as tartar emetic. In dogs and cats it has the advantage of producing emesis, when used hypodermically in doses of gr. $\frac{1}{20}$ to gr. $\frac{1}{8}$. Large doses in dogs and cats, as well as in rabbits, produce inco-ordinate manege movements, difficult breathing, and muscular paralysis. Professor Fred Smith, of the Army Veterinary Department, informs me that two grain doses given to horses stimulate the cerebro-spinal centres, producing intense delirium and nervousness, constant movement of the limbs, sweating, and every appearance of approaching dissolution.

Codeine is believed to be methyl-morphine. It is present in opium in the proportion of $\frac{1}{4}$ to 1 per cent. It is a colourless bitter alkaloid, crystallising in rhombic octahedra, soluble in 80 parts water at 60° F., in less than 2 parts of alcohol and chloroform, in ammonia, and dilute acids. Unlike morphine, it is insoluble in cold weak caustic potash, and is unaffected by ferric chloride. Like the other opium alkaloids, it exhibits the **two-fold hypnotic and stimulant action**, but its hypnotic power is slight, and, like methyl compounds of the alkaloids, it notably **stimulates the motor centres**, and full doses cause tetanic convulsions similar to those produced by strychnine or picrotoxin. It lessens irritability of the digestive tract, so that when given for several days to dogs, cats, or rabbits, irritant poisons like arsenic cause neither vomiting nor purging, and it diminishes the production of hepatic sugar, and is hence prescribed in diabetes in human patients (*Brunton*).

Thebaine or **Paramorphine** is present to the extent of $\frac{1}{2}$ per cent., is obtained in minute, colourless, rectangular prisms, melting at 380° F., has an alkaline taste and reaction, is almost insoluble in water, but soluble in 45 parts of rectified spirit, and still more so in ether and chloroform. With cold sulphuric acid it forms a blood-red solution. It has very slight hypnotic action, prominently exhibits the excitant effects of opium, stimulates the motor tract of the spinal cord, and causes, like strychnine, **muscular rigidity and convulsions**. One to two grains injected hypodermically, produce fatal tetanus in dogs (*Dr J. Harley*).

Papaverine is stated by Dr Brunton to have little physiological action. It is present to the extent of about 1 per cent., is separable in shining prisms, which melt at 297° F., is tasteless, sparingly soluble in water, soluble in dilute acetic and hydrochloric acids, and forms with cold nitric acid an orange colour. **It is a feeble hypnotic.**

Cryptopine or Cryptopia, an alkaloid discovered by Messrs T. & H. Smith, of Edinburgh, is probably a derivative rather than a natural constituent of opium, of which a ton yields only an ounce. It occurs in colourless six-sided prisms, is more bitter than morphine, and soluble in water acidulated with hydrochloric or acetic acids. One grain, injected subcutaneously, caused in dogs excitement, dilatation of the pupil, illusion of vision, agitation and frenzy. Its hypnotic action is about one-fourth that of morphine. Poisonous doses destroy life by arresting respiratory movements (*Dr J. Harley*).

Narcotine exists in opium in quantities varying from 2 to 8 per cent., and is got by treating the insoluble residue left in the preparation of morphine with diluted acetic acid, precipitating the solution with ammonia, and purifying with hot alcohol and animal charcoal. Its colourless rhombic prisms melt at 350° F., have an insipid taste, and are soluble in ether, alcohol, and weak acids ; notably in chloroform, but not in cold water. It is a feeble base, and is distinguished from morphine by having no bitter taste, no reaction on vegetable colouring matter, and no effect on ferric-chloride. Inappropriately named, it is devoid of narcotism ; is tonic and antiperiodic ; and has been used in India as a substitute for quinine in the treatment of malarial fevers. Large doses are convulsant.

Narceine constitutes 0·1 to 0·7 per cent. of opium ; occurs as a light, colourless, bitter, asbestos-like body, made up of soft needle-like crystals, melting at 293° F., soluble in 100 parts of boiling water, 400 of cold, and rather more soluble in glycerin and diluted hydrochloric acid. Somewhat contradictory opinions are expressed regarding its actions. In dogs grs. v., subcutaneously injected, produce calmative and hypnotic effects, similar to those induced by a grain of morphine. Poisonous doses arrest respiratory movements, but do not cause convulsions (*Dr J. Harley*).

Meconic Acid, $C_4HO(CO_2H)_3$, occurs in opium, to the amount of 3 to 6 per cent., and along with sulphuric acid forms the solvents for the alkaloids. The calcium meconate precipitated in the preparation of morphine is treated with hot diluted hydrochloric acid, when meconic acid is obtained in transparent, snow-white plates, which are sparingly soluble in water, but readily in alcohol; heated above 150° F. they are decomposed. It is tribasic ; forms, with neutral solution of ferric-chloride, a blood-red solution, the colour being discharged by strong but not by diluted hydrochloric acid ; and with copper ammonia-sulphate, a green precipitate. No effect is produced by eight grains given to dogs, or by four and five grains administered to men *(Pereira)*.

Physical and Chemical Tests.—Solid opium is identified by its red-brown colour, peculiar odour, and bitter taste ; simple solutions by the last two of these tests, and by the reaction of nitric acid on the morphine, or of neutral solution of ferric-chloride on the meconic acid. Such tests are, however, inapplicable in the contents of the stomach or other complex solutions, until they are freed of colouring matters and impurities. This may be effected as follows :—Reduce the solid parts of the mixture to a state of fine division, add water if necessary, acidulate with acetic acid, filter, and evaporate to the consistence of syrup. Redissolve the concentrated fluid in alcohol, boil, and filter when cool. Then evaporate the solution, dissolve the semi-solid residue in water, and filter again. If opium has been present the fluid will contain morphine meconate ; and if treated with excess of lead acetate and filtered, the clear solution so got contains morphine acetate ; the solid residue left on the filter is lead meconate ; and both solution and residue afford valuable indications of the presence of opium.

The clear solution, treated with hydrogen-sulphide to remove any traces of lead, is filtered and treated with ammonia to precipitate the morphine, which is washed, purified if necessary by solution in alcohol, and crystallises in colourless rhombic prisms. Nitric acid dissolves these crystals with effervescence, instantly producing an orange-red colour, which becomes yellow when excess of acid is used. This very delicate test is not, alone, certain evidence of the presence of morphine, as nitric acid produces the same effect on brucine and commercial strychnine. A strong neutral solution of ferric-chloride strikes a dirty-blue colour. A fragment of iodic acid, dropped into a test-tube containing a strong solution of a morphine salt, is decomposed, and the free iodine may be detected by mucilage of starch. This, however, is only a confirmatory test, as iodic acid is similarly decomposed by various albuminoids.

The solid residue left on the filter, containing as stated, lead meconate, should also be examined, as the tests for meconic acid are very delicate, and afford indication of opium even when it is in quantity so minute as to be undetectable by the morphine tests. The meconic acid may be separated from the lead either by hydrogen sulphide or sulphuric acid; the insoluble salts, thus formed, are got rid of by filtration, leaving the meconic acid in solution. *(a.)* In considerable quantity it may be purified, when it appears in colourless tabular crystals, which, when aggregated, have an appearance like spermaceti. *(b.)* Heated in a test-tube, it is partly decomposed, partly sublimed, forming radiated tufts of needle-like crystals of pyromeconic acid. *(c.)* In aqueous solution, it produces with copper sulphate, a pale green precipitate, which is dissolved by boiling, but reappears on cooling. *(d.)* But its most delicate and characteristic test is the neutral solution of ferric-chloride, which produces an intense blood-red solution of iron meconate. For all practical purposes, this test, along with the reaction of nitric acid upon morphine, is conclusive evidence of the presence of opium. Ferric-chloride produces, however, a blood-red solution with acetates, but only in strong solutions, and when the acetic acid can be easily detected by other tests, and with sulpho-cyanates existing in the saliva, especially of sheep. Two simple tests remove this source of fallacy, and readily distinguish iron sulpho-cyanate from iron meconate. Corrosive sublimate bleaches the sulpho-cyanate, but does not affect the colour of the meconate; while conversely, strong hydrochloric acid decolorises the meconate, but does not affect the sulpho-cyanate.

Actions and Uses.—Opium, morphine, and its salts in full doses paralyse the brain, but increase the irritability of the spinal cord. They cause in the domestic animals less coma, but more irregular involuntary movements than in man. They kill by respiratory arrest. Medicinal doses are anodynes, and antispasmodics, diminish congestion, and relieve inflammation, lessen intestinal secretions and peristaltic movements, and sometimes induce sleep. They are applied locally to relieve irritability and pain.

General Actions.—Opium, morphine, and its several salts **act on the central nervous system.** Their effects are twofold—(1) after a primary, usually brief stage of stimulation,

they paralyse the brain centres, causing narcosis; (2) they stimulate the spinal cord, causing involuntary inco-ordinate movements, and tetanus. As is the case with other narcotics and anæsthetics, the nervous centres are acted on in the order of their importance, voluntary motion is impaired, co-ordination is interfered with, and finally the functions of the medulla are arrested. The spinal cord loses its conducting and subsequently its reflex powers. Motor and sensory nerves seem to have their irritability first increased and then diminished. The pupil in man is contracted, although in fatal cases immediately before death, it sometimes dilates, owing to venous congestion. In horses, moderate doses generally cause dilatation; in dogs there is usually dilatation followed by contraction. The local application of the drug has no special effect on the pupil. They cause dilatation of cutaneous vessels, increasing skin secretion. The vaso-motor centre in the medulla is slightly affected by small, but paralysed by large doses. The peripheral vaso-motor apparatus also seems to be paralysed, which, Dr Lauder Brunton believes, may account for the power which opium has in diminishing congestion, and relieving inflammation. The heart does not appear to be directly affected, and blood-pressure is not altered. Opium more readily accelerates the pulse of horses and other domestic animals, than that of man, but repeated or full doses slow the heart action in all animals. The secretions generally are diminished, with the exception of the sweat and urine, which are usually increased. In most horses, however, full doses reduce and sometimes even suspend secretion of urine. Small doses increase peristalsis of the intestines, especially the small intestines; moderate and large doses diminish, and eventually arrest peristalsis—but curiously no purgative is more energetic than the injection into the jugular vein of a large dose of opium. Dogs thus experimented upon have the whole intestinal tract thrown into violent action, and its contents expelled. **Death results from asphyxia** preceded by coma, occasionally by convulsions. Morphine is **eliminated** by the gastro-intestinal mucous membrane, and also in the bile and urine.

Opium and morphine produce somewhat **different effects on the several domestic animals,** depending mainly on differ-

ences in the development of their brains, and other parts of their nervous system (p. 12). The more highly organised pschycical centres of the human brain are quickly paralysed by the drug, inducing sleep, and in large doses, coma. **Horses** exhibit more prominent and prolonged cerebral excitement, with irregular movements of the head or limbs, or both. They are easily excited, shake the head, or move it up and down, perambulate their box, or paw with one foot, often for half an hour continuously. The pulse is usually somewhat accelerated, and the pupils dilated. Large doses cause muscular twitchings and convulsions, indicating that the drug acts notably on the locomotor centres of the brain, and the motor centres of the cord. On **dogs** the effects are intermediate between those exhibited in men and horses. There is more preliminary excitement than in man, but less involuntary muscular movement than in the horse, although even during drowsiness and sleep muscular twitchings occur. In rabbits the motor and spinal centres are also prominently affected, and convulsions are more notable than hypnotism. **Mice** receiving a fraction of a grain of morphine are affected by restlessness, spasms, and irregular breathing, but sleep is an after effect, produced only when dangerous doses are given. **Birds** are curiously insusceptible, do not sleep, or show any alteration of the pupil; but 10 grains swallowed by pigeons, or 3 grains injected hypodermically, cause inco-ordinate movements, laboured breathing, convulsions and death. **Frogs** receiving an injection of one to two grains are convulsed, paralysed, and die from respiratory arrest.

Toxic Effects.—Opium and its preparations annually destroy in Great Britain upwards of one hundred lives, three-fourths being children under five years. In the domesticated animals, accidental poisoning with opiates occurs occasionally, intentional poisoning very rarely.

Horses of different temperaments are somewhat differently affected. Exciteable well-bred subjects are difficult to bring under the anodyne and soporific effects of the drug. Hertwig mentions that two to four drachms produce slight stimulation; and that an ounce in solution caused first increased liveliness, and, after two hours, dulness, diminished sensibility, slower

circulation, less frequent evacuations, and stupor—symptoms which continued for twelve hours, but entirely disappeared the following day. Two ounces and a half induced similar effects, with convulsions and death in about twenty hours. Dr John Harley found that four drachms powdered opium caused little effect for seven hours, and then only acceleration of the pulse. Even four ounces laudanum are stated to have had little effect. (*Old Vegetable Neurotics*).

I gave a strong healthy cart-horse one ounce powdered opium dissolved in water; the pulse in eight minutes fell from forty-four to thirty-four beats per minute; the superficial muscles were relaxed, the nasal mucous membrane blanched, and the animal was dull and dejected. From disease of the eyes the condition of the pupil could not be noted. After half an hour, four drachms, also dissolved in water, were given, and increased the dulness and lowered the pulse, to thirty-two. Half an hour later the animal, continuing in the same state, was destroyed by cutting the carotid artery. A mare, aged and rather feeble, had drachm doses in solution thrice a day: she exhibited dulness, loss of appetite, torpidity of the bowels, diminished force of the pulse, and died on the fourth day, after the exhibition of nine doses. One drachm given thrice a day to a healthy donkey, after six doses, induced acceleration of the pulse to eighty-eight, restlessness, vertigo, nausea, champing of the teeth, and death on the third day.

Dr John Harley and Messrs Mavor made an interesting series of experiments with **morphine salts on horses,** and published the results in the *Old Vegetable Neurotics.* Morphine acetate grs. iv., injected hypodermically, accelerated the pulse by 20 to 28 beats, and increased alike its force and volume, produced restlessness, pawing, increased moisture of the mouth and skin, elevation of temperature, and slight dilatation of the pupils. Twelve grains, dissolved in three drachms of water, injected by three punctures, produced light drowsiness, giving way after three hours to excitement, restlessness, and slight delirium, continuing about six hours. Thirty-six grains, in seven drachms of water, introduced by three punctures into a seven-year-old hunter, in good condition, caused drowsiness and stupor, coming on in fifteen minutes, and continuing for three

hours, slight muscular tremors, awkward staggering gait, leaning against the sides of his box, dilated and fixed pupils, blindness and insensibility to light; the respiration, at first slow and sighing, gradually became accelerated. The dilatation of the pupil is opposed to the contraction so constantly seen in man. After the third hour, restlessness and delirium set in, continuing for seven hours; he walked rapidly, and even ran round his box; his pulse was 96, full and thrilling; the skin damp with perspiration; the membrane of the eyes, nose, and mouth intensely injected. For twenty-four hours the effects continued; the secretions were, however, unaffected, but the horse was left exhausted.

Mr F. Mavor, experimenting with a well-bred three-year-old colt, injected subcutaneously 4 grs. morphine; in two hours the pulse had risen from 36 to 64; the temperature advanced fully one degree, to 101° F.; two hours later the pulse was 56, the temperature remained the same, the pupils were dilated, the patient restless, the tongue moist; the effects gradually abated, and disappeared in twenty-four hours (*Veterinarian*, January 1874).

Mr A. E. MacGillivray, Banff, who has used morphine hydrochlorate hypodermically for years, states that in susceptible horses he has repeatedly found grs. iv. or grs. v. induce staring eyes, restlessness, prancing round the box, increased rapidity and threadiness of the pulse—symptoms which sometimes continue three to five hours (*Veterinarian*, March 1881).

Mr Fred. Smith and Mr C. Rutherford, of the Army Veterinary Department, have recently made a series of experiments with alkaloids at Aldershot, and obligingly furnish me with the following notes. A bay gelding had 3 grs. morphine injected hypodermically, and in fifteen minutes had shaking of the head, which continued more or less for a couple of hours, but there were no other appreciable symptoms. A bay gelding, fed on hay and grass in October 1887—during warm weather—with a pulse of 38, respirations 12, and pupil $\frac{1}{2}$ inch vertical diameter, had 5 grs. morphine injected. In forty minutes the pulse was 42, respirations and pupils unchanged. He walked occasionally round his box, threw back his ears; a patch of perspiration appeared on the breast, around the seat of injec-

tion; the head was frequently shaken; the animal was easily started. The effects wore off in about an hour and a half.

In experiments where **morphine and atropine** were **injected together,** Mr C. Rutherford records that the horses were more readily excited than when morphine was given alone. They moved almost constantly round the box, had rythmical movements of the head, and dilated pupils. Morphine 5 grs., injected with 15 ♏. B.P. atropine solution, caused in fifteen minutes uneasiness, walking round the box, throwing up, and shaking of the head, slight pawing, dilated pupils, nervousness, and excitability. These symptoms continued for one and a half hours, when they gradually abated; but the animal, for six hours, still remained easily excited, and a "little on the move."

Twelve grains morphine acetate, dissolved in a pint of water, and swallowed by a horse, had no effect beyond increasing the pulsations eight beats (*Old Vegetable Neurotics*). One hundred grains acetate, swallowed in solution, killed a horse with convulsions in three hours (Dr H. C. Wood's *Treatise on Therapeutics*).

Ruminants are not so susceptible as horses, especially of opiates given by the mouth. Cows taking an ounce, and sheep four drachms, exhibit dryness of the mouth, occasional nausea and restlessness, acceleration, and subsequently slight slowing of the pulse. **Swine** receiving one or two drachms become first lively and then dull and sleepy, their bowels constipated, and their skins hot.

Dogs swallowing moderate doses usually become stupid and drowsy; but occasionally are rendered delirious, especially by large doses. The pupil is not dilated, as is frequent in the horse or cat, nor continuously contracted, as in man, but is contracted while the dog is asleep or narcotised. One to three drachms usually cause, within a few minutes, increased force and frequency of the circulation; there is nausea, a staggering, unsteady gait, twitching of the limbs, clonic spasms, stertorous breathing, and, as death approaches, stupor—never, however, so deep or lasting as in human patients, and from which the animal may always be easily roused. The symptoms continue from three to fifteen hours; and most animals sur-

viving the latter period recover. Dr Harley injected 20 minims laudanum under the skin of a bitch about 25 lbs. weight; she was nauseated; in fifteen minutes she vomited; had spasms of the diaphragm, the bowels acted, mucus ran from the mouth; within an hour the pulse had fallen from 120 to 78, and was irregular; the animal lay quiet, but did not sleep or shew narcotism. Twenty minims more were injected; the pulse fell to 72 and was regular, respiration 16 and regular; half an hour later she closed her eyes and was drowsy, continued so for an hour, but did not actually sleep.

Morphine acetate, half a grain, subcutaneously injected by Dr Harley into a bitch weighing 25 lbs., in a few minutes caused vomiting and urination. She lay motionless, her nose on the rug, her fore and hind limbs fully extended. For upwards of three hours she was so completely narcotised that the eyes were insensible to light; the pupils much contracted; the pulse fell from 120 to 50, and became irregular; the respirations went down from 20 to 14, and were shallow; the muscles were flaccid. Two to three grains subcutaneously injected killed dogs of 12 lbs. to 16 lbs. in ten or twelve hours; doses insufficient to kill develop in most dogs excitant instead of soporific effects. The spinal cord is more notably acted on than the brain; there are vomiting, nausea, restlessness, and delirium.

Post-mortem discovers the appearances of asphyxia. The blood is fluid and dark-coloured from imperfect decarbonisation, but it does not yield on analysis any indications of the poison. There is general venous engorgement; the lungs and brain are specially congested. The ventricles of the brain and subarachnoid spaces contain more serum than usual.

ANTIDOTES.—Any unabsorbed poison is to be promptly got rid of either by the stomach-pump or by emetics, and the latter are more effectual alike in men and dogs, so long as the patient can swallow. Mustard and warm applications to the chest counteract cramp of the respiratory muscles, and sustain the action of the heart. Artificial respiration, dashing alternately cold and hot water over the head and neck, and faradising the muscles of the chest, antagonise paralysis of respiration. Strong coffee, stimulant clysters, and keeping

the patient moving, counteract the tendency to stupor. The stupor, depression of heart-action, and paresis of respiration are counteracted by subcutaneous injection of the B.P. atropine sulphate solution, ♏ xl. being used for horses, ♏ i. for dogs, the injection being repeated every ten or fifteen minutes until evidences of recovery are manifest. Strychnine and picrotoxin, on account of their stimulating the respiratory and vaso-motor centres, also antagonise morphine poisoning. Tincture of galls and other chemical antidotes are of little avail.

MEDICINAL USES.—No articles of the Materia Medica are more frequently and generally prescribed than opium and morphine. As stimulants and restoratives, they sometimes act almost like food or alcohol. The Cutchie horsemen share their opium with their jaded steeds, and increased activity and capability of endurance are observed alike in man and beast. Opium and morphine, under favourable conditions, depress the functional activity of the brain, render it anæmic, and **produce sleep,** especially in men and dogs. They **diminish** excessive **irritability and sensibility,** and thus relieve pain and counteract spasm. When morphine is injected hypodermically twenty to thirty minutes previous to the inhalation of chloroform or ether, the anæsthesia is intensified and prolonged.

From their diminishing the activity of the vaso-motor centre, as well as the sensibility of the terminations of vaso-motor nerves, they **relieve congestion and inflammation** and **abate pain** (*Brunton*).

In **gastritis,** or gastro-enteritis, whether produced from disease or from swallowing acrid poisons, opium is of value in allaying irritability, pain, and spasm. Obstinate chronic **vomiting,** either in dogs or pigs, whether depending upon irritation of the stomach or of the vomiting centre, is generally relieved by a few grains of opium given with chloroform, or chloral hydrate. In gastric irritability it is sometimes prescribed with bismuth. When, in weakly, young, growing animals, food is hurried too rapidly through the digestive canal, opium checks excessive secretion and peristalsis, and, conjoined with mineral acids or arsenic, should be given shortly before feeding.

Diarrhœa, whether occurring from congestion of the ali-

mentary mucous membrane, or as a symptom of other ailments, is often removed by a laxative which carries away offending matters. Occasionally, however, the intestines continue irritable and relaxed : opium in such cases abates irritability, diminishes excessive secretion, and is administered with well-boiled starch gruel, sometimes conjoined with an antacid, sometimes with acids, bitters, or vegetable astringents. For such purposes, the following recipes are used alike in horses or cattle :—A drachm each of powdered opium, kino, gentian, and sodium carbonate ; or a drachm of opium, a drachm of powdered galls, or half a drachm of tannin, with half an ounce of chalk. These drugs may be made into bolus with treacle or meal and water, or dissolved in ale or gruel, and given twice daily, or as required. An ounce of laudanum, thirty drops sulphuric acid, two drachms powdered catechu, with an ounce of ginger, aniseed, or fenugreek, make an astringent anodyne drench for diarrhœa in cattle, and may be given in gruel, ale, or spirits and water. Another useful prescription for relaxed bowels consists of an ounce each of laudanum, decoction of oak bark, ginger, and sodium carbonate, given several times daily in starch gruel. One-third of this dose suffices for six months' calves. For dogs, Stonehenge mixes three to eight drachms laudanum, two to three drachms chalk, one drachm aromatic confection, and two drachms gum arabic, dissolved in seven ounces of water ; and of this mixture orders one or two table-spoonfuls every time the bowels are relaxed.

In **dysentery,** whether in horses, cattle or dogs, opium is of service in allaying pain and straining, and may usually be freely given along with antiseptics both by the mouth and rectum. A drachm each of powdered opium and galls, with half a drachm copper sulphate, may be repeated twice a day either for horses or cattle. Whilst febrile symptoms continue, any such opium mixture must be used cautiously, and an occasional laxative may be necessary. In gastro-intestinal cases opium is generally contra-indicated when secretion is impaired, or the liver or kidneys act imperfectly.

Antagonising muscular spasm, opium and morphine are valuable in **spasmodic colic** in horses, being usually conjoined

with such stimulants as ether, sweet spirit of nitre, chloral hydrate, chloroform, spirit of ammonia, or oil of turpentine, and with such laxatives as aloes and linseed or castor oils. For general service, four or five drachms of aloes are rubbed down in a quart of tepid water, and when the solution is nearly cold, an ounce each of laudanum and ether is added; while in large horses the dose of the anodyne and stimulant may be doubled. If more convenient, the aloes may be given in bolus, the laudanum and ether in draught.

As an antispasmodic for the dog, Stonehenge advises half a drachm to a drachm each of laudanum and ether, given in an ounce of camphor mixture. Professor Fred Smith, A.V.D., informs me of the following case, illustrating the powerful antispasmodic effect of morphine on the dog:—A collie poisoned with strychnine, and so convulsed that recovery seemed impossible, had five grains morphine injected hypodermically, the muscular spasms ceased, he slept for twenty-four hours, and recovered.

In **enteritis** in horses, Professor Robertson used half a drachm each of powdered opium and camphor, with 5 minims Fleming's tincture of aconite, in a pint of gruel, with or without a dose of oil. In the rapidly fatal **muco-enteritis** amongst the heavier descriptions of hard-worked horses, opium and calomel were wont to be prescribed in the earlier stages, and opium, belladonna, chloral hydrate, and ether in the second stages; but more prompt measures are needful to avert the deadly passive hæmorrhage, and the most successful treatment consists in hypodermic injection of morphine and atropine—sometimes used with ergotin—and repeated every two hours.

In **peritonitis,** whether common or puerperal, the chief hope of cure lies in the early frequent administration of full doses of opium, which control inflammation, exudation, and passive hæmorrhage, and lessen irritability and pain. Where acute pain is to be blunted or violent spasm counteracted, large and repeated doses are conjoined with belladonna extract, and given in solution. In such circumstances there is little fear of bad consequences, for the system attains great toleration both of narcotics and stimulants. **Obstruction of the bowels** from dust-ball, strangulation of the intestine, or intussusception,

are usually hopeless, but the most promising treatment consists in full doses of opiates, which combat spasm, irritation, and pain, and in displacement of the bowels, may facilitate restoration of the parts to their normal position.

Diseases of the respiratory organs, with shallow, embarrassed breathing, are unsuitable cases for full doses of either opium or morphine, which are apt still further to depress respiratory function, and favour death by apnœa. **Pleurisy,** however, may be treated by larger and more frequently repeated doses than bronchitis or pneumonia. They diminish excitability of the respiratory centre, and hence **relieve cough,** irritability and pain of the throat and chest. Belladonna and opium, although in large doses opposed in their effects on the respiratory centre—the former acting as an excitant, the latter as a depressant — in medicinal doses are sometimes advantageously conjoined in allaying bronchial irritability. In the **catarrhal epizootics** of horses, after a few doses of salines, half a drachm each of opium and belladonna extract, conjoined with an ounce of spirit of chloroform, ether, or sweet spirit of nitre, and repeated two or three times daily, frequently abates vascular congestion and cough, and besides improves appetite and strengthens the pulse. A similar prescription answers in **asthma**—a common complaint in dogs; but in this, as in other diseases, more prompt and certain effects are obtained by the hypodermic injection of morphine and atropine.

Rheumatism is sometimes advantageously treated with opium, prescribed in the earlier and more acute stages with calomel and salines; and in more chronic cases used both locally and generally, and along with turpentine and other stimulants, smart friction, and warm clothing. Neuralgic pains occurring in horses, and causing puzzling—sometimes frequently-shifting—lameness are checked and occasionally cured by opium, and still more effectually by morphine injected deeply into the affected muscles.

American practitioners prescribe both opium and morphine, given by the mouth and hypodermically, for combating the rigidity and pain of **spinal meningitis.** **Tetanus,** occurring in young animals from exposure to cold, is often successfully treated by opium, especially when conjoined with chloral

hydrate or conium; while in the more serious cases amongst adults, spasms and morbidly acute sensibility have been removed for several hours by the hypodermic injection of morphine, deeply inserted into the tetanised muscles. In **hysteria** it is prescribed with potassium bromide and camphor.

Opiates are of service alike in mares, cows, and bitches, in allaying the **post-partum irritability** and **straining,** which occur in such cases, being sometimes conjoined with chloral or chloroform. Morphine, used either by the mouth or hypodermically, alone—or, better still, conjoined with atropine—is often effectual in arresting **premature labour pains.** Some practitioners recommend opiates in rabies and chorea, but they are of little use in either. They were formerly used in polyuria amongst horses, but are not so effectual as iodine. Although powerless to arrest phthisis pulmonalis, they are often serviceable in relieving the accompanying cough and diarrhœa.

Opiates are **contra-indicated** in acute fever, with a hot and dry skin and a full and strong pulse, in congestive and inflammatory diseases of the brain, and in obstinate constipation. Full doses, depressing respiratory functions, prove injurious where there is tendency to death by apnœa.

Externally, opium is used to relieve the pain of wounds, bruises, boils, blistered and cauterised surfaces, and superficial inflammation of the eye, skin, or joints. For such purposes five to ten drops each of laudanum and Goulard's extract may be mixed with an ounce of water. As a topical anodyne, its efficacy is often increased by combination with belladonna, chloral hydrate, or aconite. A dressing of soap-liniment, mixed with opium tincture, often allays irritability and pain in bronchitis, pleurisy, and arthritis; or in such cases a flannel wrung out of hot water may be applied, moistened with the anodyne solution. Along with borax or alkaline carbonate, it is useful in abating the irritation of prurigo and acute eczema. Boils and carbuncles may sometimes be dispersed by freely saturating them with a strong opiate solution or ointment, covering with a piece of oiled silk, and applying a large poultice. For hæmorrhoids, opium is conjoined with gall ointment. It is the anodyne chiefly relied on for injections and suppositories in enteritis and dysentery, as well as in

irritation and inflammation of the uterus, kidneys, bladder, and rectum. The uterus vagina and urinary bladder, when everted, should be washed with tepid water moistened with a solution of opium and belladonna, carefully returned, and retained in position by appropriate measures. As a clyster, opium is used in about the same quantities as are given by the mouth. When the skin is tender or abraded, especially in small and young animals, opiates must be applied cautiously, lest they become absorbed, and produce undue constitutional effects.

DOSES, ETC.—Of **solid opium,** horses take ʒi. to ʒij.; cattle, ʒij. to ʒiv.; sheep, grs. x. to grs. lx.; pigs, grs. v. to grs. xx.; dogs, gr. i. to grs. vj.; cats, gr. ss. to grs. ij. Of **morphine and its salts** horses and cattle take grs. iii. to grs. x.; sheep and pigs, gr. ss. to grs. ii.; dogs, gr. $\frac{1}{8}$ to gr. $\frac{1}{2}$, given in pill or dissolved in diluted spirit slightly acidulated, either with hydrochloric or acetic acid. For hypodermic injection, not more than the minimum doses mentioned should in the first instance be used. Tabloids containing one or more grains or fractions of grains of morphine salts are convenient especially for hypodermic use.

Tolerance alike of opium and morphine is increased by acute pain and continued use. Special **susceptibility** is observable in young animals, in which accordingly reduced doses must be used. Although opium and morphine salts closely resemble each other, the crude drug is more apt to cause gastric disturbance and constipation, while the alkaloid is more effectual in arresting pain, especially when used hypodermically.

The several actions are altered, intensified, or repressed by **combination with other drugs.** Hypnosis and quieting of nervous excitability are determined by combining the opiate with Cannabis indica, chloral hydrate, and bromides; antispasmodic effects, by conjunction with ethers or volatile oils; the checking of intestinal secretion by prescription with lead acetate, tannic or sulphuric acids; sudorific action is promoted by ipecacuanha, ammonium acetate solution, diluents, and warm clothing; anodyne properties are increased by combination with atropine, and occasionally with aconite or prussic acid; while in malarial fevers, Indian and American practitioners prescribe opiates with quinine.

Veterinarians do not use so many preparations as are employed in human medicine. **Crude opium** is given to horses and dogs made into bolus or pill, and no other solid form is necessary. To reduce it to powder, it is first dried in a vapour bath, and its trituration is facilitated by mixture with potassium sulphate, or other hard salt. The **extract,** though somewhat less bulky than crude opium, has the disadvantage of being frequently made at a high temperature at which the resinous matters unite with the alkaloids, forming compounds which are insoluble and of diminished activity. **Dover's powder,** the pulvis ipecacuanhæ compositus, consists of one part each of powdered opium and ipecacuan, and eight parts potassium sulphate, added to facilitate trituration and intermixture of the vegetable matters. It is given to dogs as a febrifuge, in doses of grs. iij. to grs. x. A **watery solution,** made by rubbing down opium in hot water, and giving both dissolved matters and residue, has the merit of being cheaper than the tincture, and is more prompt and effectual than the solid drug.

Tincture of opium, popularly known as laudanum, is thus prepared by the B. P. process:—"Take of opium in coarse powder an ounce and a half; proof spirit, one pint; macerate for seven days in a closed vessel, with occasional agitation; then strain, press, filter, and add sufficient proof spirit to make one pint." This brown-red tincture has the odour and taste of opium, and the specific gravity ·942. It contains the alkaloids, resinous and odorous matters in a convenient and soluble form. An ounce contains the soluble matters of nearly 33 grains of opium, or about 3·3 grains of morphine. Evaporation of a known quantity, and weighing the residuum, are the best safeguards against adulteration. An ounce of good laudanum leaves 17 to 22 grains of residue. For immediate effects laudanum is usually preferable to solid opium. The dose for horses and cattle is f℥i. to f℥iij.; for sheep and pigs, fʒii. to fʒvi.; for dogs, ♏xv. to ♏xl.

The **vinegar** and **wine** of opium are seldom used in veterinary practice. An **ammoniated tincture** known as Scotch paregoric, is prepared by macerating for seven days 100 grains opium with 4 fluid ounces strong ammonia solution and 16 ounces of rectified spirit; to which the B. P. adds saffron

benzoic acid and oil of anise. A **camphorated tincture**, known as English paregoric, is made with opium 40 grains, benzoic acid 40 grains, camphor 30 grains, oil of anise $\frac{1}{2}$ fluid drachm, proof spirit 1 pint. Laudanum and soap liniment, mixed, make an excellent anodyne, much used externally.

PEPPERMINT.

OLEUM MENTHÆ PIPERITÆ. Oil of Peppermint. The oil distilled in Britain from fresh flowering peppermint, Mentha piperita. (B. P.) *Nat. Ord.*—Labiatæ.

The natural family Labiatæ furnishes peppermint, spearmint, penny-royal, lavender, rosemary, marjoram, and thyme; and from these plants, when fresh flowering, aromatic antiseptic volatile oils are obtained. Similar oils are extracted from the leaves of various Myrtaceæ from the petals of roses, from the flowers and fruit of various Aurantiæ, and from the seeds of various Umbelliferæ (p. 146).

Of the Labiatæ volatile oils peppermint is the most commonly used. The fresh plant yields 1 to 1·25 per cent. of the colourless or pale yellow oil, which is characterised by its warm aromatic taste and subsequent sensation of coldness, and by the varied and beautiful colours and fluorescence, produced when it is acted on by nitric acid. It consists of two isomeric oils—the fluid **menthene** $C_{10}H_{18}$, and the solid or crystalline **menthol**, $C_{10}H_{20}O$, which is homologous with thymol, the stearoptine of the oil of thyme.

ACTIONS AND USES.—Oil of peppermint is antiseptic, carminative and parasiticide.

It resembles oil of thyme and other volatile oils. It is more active than the oil from Mentha viridis, or spearmint, or the M. pulegium or penny-royal. Diluted solutions arrest the development of bacilli as effectually as carbolic acid, or eucalyptus oil, and it is hence sometimes used as a dressing for wounds, and as a gargle in ulcerated or diphtheritic throats. It has been employed to arrest ringworm and destroy skin parasites. It paralyses the ends of sensory nerves with which it is brought into contact, and hence relieves gastric,

neuralgic, and other pains. For **external** application a pencil of menthol is gently rubbed over the painful surface, solution being promoted by wetting with a little spirit Increased anodyne effects are obtained by rubbing up the menthol with equal parts of thymol, carbolic acid, or chloral hydrate. Peppermint oil is used to prevent the nausea and spasms sometimes produced by purgatives, to flavour medicinal preparations, or cover their unpalatable taste.

Doses, etc.—For horses and cattle, ♏ xx. to ♏ xxx.; for dogs, ♏ iii. to ♏ v., given on a piece of sugar or in spirit and water. Peppermint water contains one and a half fluid drachms of oil to the gallon of water. The essence consists of one part of oil to four of rectified spirit.

PEPPERS.

The black and white peppers in daily domestic use are obtained from the brown wrinkled berries of an East Indian perennial climbing plant—the Piper nigrum, of the natural order **Piperaceæ.** They are imported from the Malabar Coast, the islands of the Indian Archipelago, and the West Indies. The pendulous spike, bearing 20 to 30 berries, is gathered as it begins to redden shortly before ripening, and is dried in the sun. The berries rubbed off, and ground without separating their outer covering, yield **black pepper.** To prepare the milder **white pepper,** the best and soundest ripe berries are steeped in water, and stripped of their pungent outer covering before they are ground. **Long pepper,** the produce of Chavica Roxburghii, is brought from Singapore and Batavia, and consists of small, closely-attached berries, arranged on cylindrical grey spadices one or two inches long.

The peppers when ground have a hot, pungent, spicy taste, and owe their properties to 1·6 to 2·2 per cent. of a **volatile oil**—isomeric with oil of turpentine ($C_{10}H_{16}$), a soft, pungent **resin,** and 2 to 3 per cent. of the colourless crystallisable, neutral **piperine** $N(C_5H_{10}).(C_{12}H_9O_3)$, which when boiled with potash yields an active oily alkaloid piperidine $N(C_5H_{10})H$.

Cubebs or Cubeba, are the dried partially ripened fruit of

the Peper Cubeba, cultivated in Java and other islands of the Indian Archipelago. The berries are stalked and lighter coloured than those of common pepper, are globular, rough, and wrinkled, with a strong odour, and pungent, aromatic, bitter taste. They contain a volatile oil, a resin, and the neutral crystalline cubebin, which is devoid of any marked action.

Piper angustifolium, a shrub found in moist regions throughout Brazil and Peru, yields the **matico leaves**, much used in America as a styptic dressing, and also occasionally administered for the arrest of internal hæmorrhage.

Pimenta, pimento, Jamaica pepper, or allspice, closely resembles the true peppers; is the dried unripe berry of Pimenta vulgaris, an evergreen West Indian tree of the natural family Myrtaceæ. The berries are about the size of those of the Piper nigrum, have the same penetrating aromatic odour, and hot, pungent taste, but are more truly aromatic and less acrid. They contain an acrid **fixed oil**, and about 6 per cent. of **volatile oil,** resembling oil of cloves, with traces of **an alkaloid**, having the odour of coniïne (*Flückiger*).

Capsicum—the dried ripe fruit of Capsicum fastigiatum—is also known as Chili pepper, chillies, Guinea or pod pepper, and, although originally brought from America, British supplies now come chiefly from Zanzibar. The pods of the several varieties differ in shape and size, are of a red colour, and filled with numerous small round or ovoid red-brown seeds. Both pericarp and seeds are pungent, and when ground, constitute the familiar **Cayenne pepper,** which owes its pungent acridity and irritant properties to an acrid volatile substance—**capsaïcin** ($C_9H_{14}O_2$), and an alkaloid resembling coniïne in odour.

Actions and Uses.—The peppers are irritants, stimulating stomachics, and rubefacients. Large doses, especially in carnivora and omnivora are irritant poisons, inflaming the alimentary, and sometimes also the urino-genital mucous membranes. That they are especially poisonous to pigs is a popular error. Properly regulated doses promote salivary and gastric secretions; are stomachic and carminative; and during their excretion, stimulate the urino-genital mucous membrane. Rubbed into the skin they cause redness, irritation, swelling, and sometimes suppuration. The several peppers differ in the

intensity of their action. The black is more active than the white and long peppers, which are of nearly equal strength. Pimento is less active; while capsicum and Cayenne are more irritant than black pepper. In virtue of its stimulant effects, and its rendering the urine antiseptic, cubebs checks irritation, and discharges from the urino-genital mucous membrane.

Black pepper, the variety chiefly used in veterinary practice, is administered in simple indigestion, and for obviating the disagreeable taste and nausea of varions drugs. It is not now given as a sialogogue, nor for the object of increasing sexual appetite, which, when defective, may usually be restored, not by irritating drugs, but by measures which improve general vigour. It ought not to be used for blistering ointments, or for smearing setons; nor introduced into the rectum of horses exposed for sale—a barbarous practice, apt to induce serious intestinal irritation.

Doses, etc.—Of black pepper, as a stomachic, horses take about ʒ i.; cattle, ʒ ij.; sheep and swine, grs. x. to ʒ ss.; dogs, grs. v. to grs. x.; repeated two or three times a day, given in bolus, dissolved in water or spirit, or suspended in well-boiled gruel.

PEPSIN.

A preparation of the mucous lining of the fresh and healthy stomach of the pig, sheep, or calf.—(B. P.).

Pepsin is prepared by several processes. The mucous surface is cleansed of food and other impurity, slightly washed with cold water, the surface scraped with a blunt knife, and the viscid pulp thus obtained dried at a temperature not exceeding 100° F. Thus prepared especially from the stomach of the calf, the pepsin is mixed with other two ferments—one which curdles milk, probably by hydration of the casein, and another which decomposes milk sugar, producing lactic acid (*Textbook of Human Physiology—Landois and Stirling*).

Actions and Uses.—Pepsin dissolves albuminous and gelatinous articles of food, transforming them into peptones, but has no effects on fats or starch. In herbivora, its therapeutic value is hence limited to young animals while receiving

milk, and to dogs living chiefly on animal food. In such patients it is given along with or immediately after meals. When gastric secretion in the domestic animals is at fault, it is more probably from deficiency of the acid than the pepsin, and such a condition is appropriately treated by hydrochloric acid, administered with or after meals.

DOSES, ETC.—Foals, calves, and dogs take grs. ij. to grs. x., usually given in water, with a few drops of hydrochloric acid. The pepsin wines and essences seldom contain much of the ferment.

PETROLEUMS OR PARAFFINS.

The petroleums or paraffins are hydro-carbons produced by the decomposition of vegetable matter. They are obtained from the destructive distillation of coal, from bituminous shales, and from the oil-wells found in various parts of the world. They occur as gases, fluids, and solids, and many are used in the arts and in medicine. The simplest of the series is **marsh gas, methane,** fire-damp, or light carburetted hydrogen (CH_4)—the inflammable gas which causes coal-pit explosions. The members of this homologous series all contain C and H in the proportion expressed by the formula $C_n H_{2n} + 2$ where n represents any whole number.

The following are the chief members of the series present in the rock-oil got on the Caspian coasts, and from the oil-wells of Canada or Pennsylvania. They differ in specific gravity and boiling point, which rises with the number of the carbon atoms. The liquids with a low boiling point are more volatile, and have more activity than those which have a higher boiling point:—

Methane,	CH_4	gas			Fluid, boils at
Ethane,	$C_2 H_6$	„	Heptane,	$C_7 H_{16}$	98° C.
Propane,	$C_3 H_8$	„	Octane,	$C_8 H_{18}$	125°
Butane,	$C_4 H_{10}$	„	Nonane,	$C_9 H_{20}$	148°
		Fluid, boils at	Decane,	$C_{10} H_{22}$	168°
Pentane,	$C_5 H_{12}$	38° C.	Dodecane,	$C_{12} H_{26}$	202°
Hexane,	$C_6 H_{14}$	70° C.	Hexadecane,	$C_{19} H_{34}$	278°

When **rock-oil** is distilled, ethane and other gaseous

paraffins are first evolved, are collected, and in great part liquefied by a condensing pump, and yield the liquid **cymogene,** which, on account of the cold produced by its rapid evaporation, is used in freezing machines. Proceeding with the fractional distillation, the products which come off below 170° F., and consist chiefly of pentane and hexane, are sold as **petroleum spirit** or petroleum ether, and are used for making varnishes for dissolving indiarubber, and for singeing horses; but are not safe for burning in ordinary lamps, as they readily evolve inflammable vapours, which form explosive compounds with air. The next portion of the distillate, coming off about 212° F., is heptane, and is used for illuminating purposes under the names of **benzoline, paraffin oil,** or mineral sperm oil. For safe use such oils, when placed in an open saucer at 100° F., should not kindle when a light is brought near their surface. The petroleum distilling over between 300° and 400° F. is chiefly nonane and dodecane, and is used for lubricant purposes. At higher temperatures hexadecane and other paraffins, richer in carbon, come off, constituting soft solids, such as **vaselin** and the **soft petroleums**: while at still higher temperatures are produced the **hard paraffins,** or paraffin waxes. These soft and hard paraffins are also often got by distillation from shale; the liquid portions being separated by refrigeration, and the solid products purified by melting and filtration. They are frequently substituted for oils, lard, and wax, in the making of ointments.

The **Rangoon petroleum,** obtained from wells on the Caspian shores, and the analogous Barbadoes or **mineral tar,** found in the Island of Barbadoes, floating on the surface of springs or pools, and in Trinidad forming extensive beds or lakes, are of the consistence of treacle, of a dull green-brown colour, with a petroleum odour and a bitter taste.

Actions and Uses.—The petroleums **belong physiologically to the fatty or alcohol series of hydro-carbons.** Methane, ethane, and the gases low in the series, and the more volatile liquids, are more easily absorbed and excreted than the heavier liquids and solids, and are stimulants, anæsthetics, and inebriant narcotics. Petroleum benzin, or

petroleum ether, must be distinguished from the benzine (C_6H_5H) obtained from the distillation of coal-tar, and which has a higher specific gravity and a higher boiling point (p. 270). Petroleum benzin is used as a vermicide, killing effectually even tape-worms. The dose for horses is f℥ij. to f℥iv.; for dogs, ♏xx. to ♏xxx., given in milk or gruel.

Animals are sometimes poisoned by the refuse oils from petroleum works contaminating the drinking water. Professor Williams records cases of cattle suffering from diarrhœa, wasting, and anæmia, and their intestinal glands being found saturated and darkened with the oil (*Principles and Practice of Medicine*).

The petroleum ether and paraffin oils, in virtue of their diffusive, solvent, stimulant, and antiseptic actions, are applied in scaly skin complaints, as in old-standing cases of grease in horses, in order to remove scurf and dissolve accumulated sebaceous matters, stimulate the dermis, and promote growth of hair. For such purposes they are frequently used in conjunction with alkalies, bland oils, or vaselin. They destroy the cryptogamic growth of ring-worm, and kill skin parasites. For mange and scab, they are united or alternated with sulphur, iodine, or solutions of tobacco or stavesacre.

Vaselin—the petrolatum of the U.S.P.—is prepared by the Chesebrough Manufacturing Company, New York, by heating rock-oil in iron retorts, and filtering the residual heavier oils through animal charcoal. It is red, yellow, or white, according to the proportion of colouring matter retained. It has the consistence of summer butter, is tasteless, odourless, and neutral. It melts about 95° F., and boils about 300° F. It is insoluble in water, glycerin, cold alcohol, and ether, but is soluble in chloroform, carbon disulphide, and in fixed and volatile oils. It dissolves bromine, iodine, sulphur iodide, and carbolic acid, as well as fixed and volatile oils and alkaloids, and is a serviceable basis for ointments, liniments, and pomades. It has the advantage of being nearly free from greasiness; it is not oxidisable, and hence does not become rancid. Ointments prepared with it accordingly keep better than those made from animal and vegetable fats. It is used as a lubricant and emollient for irritable, inflamed, or blistered

mucous and skin surfaces. It is a convenient basis for electuaries for sore throat. It is used for making up boluses, and as a protective for leather and cutlery.

Rangoon and Barbadoes tar were at one time prescribed in chest diseases and as anti-emetics, but are not now used internally. Externally, they are applied for the same purposes as wood-tar, and particularly in the treatment of skin complaints, thrush, canker, and other diseases of the feet. **Coal-tar** differs from Barbadoes tar in having a stronger and more offensive sulphurous smell, but it deserves its popular credit as an antiseptic and stimulant adhesive for diseases of the feet.

PODOPHYLLUM—PODOPHYLLIN.

Dried rhizome and rootlets of Podophyllum peltatum, from which the resin Podophyllin is extracted by rectified spirit. *Nat. Ord.*—Ranunculaceæ.

The Podophyllum, May apple, or Mandrake, is a perennial herbaceous plant, plentiful in the Northern States of America, where its subacid fruit is eaten under the name of wild lemons. The root is imported in flattened cylindrical pieces of variable length, one-fifth to one-third of an inch thick; marked with irregular tuberosities giving off brittle brown rootlets. It is reddish-brown externally, white within, and breaks with a short fracture. The powder has a yellow-grey colour, a narcotic disagreeable odour, a bitter, sub-acrid, nauseous taste.

The resin podophyllin is prepared from a strong tincture made by exhausting the root with rectified spirit. It is a greenish-brown amorphous powder, soluble in water, ether or ammonia, and consisting of an inert fatty resinous acid, and two amorphous bitter **active resins**—podophyllotoxin and picropodophyllin, the former being the most powerful.

Actions and Uses.—Both the root and resin are topical irritants, and drastic purgatives. The resin especially increases not only the secretions of the bowels, but stimulates the hepatic cells, and hence increases secretion of bile. In dogs and cats, as in human patients, it is an emetic. Repeated

doses in horses and dogs reduce the force and frequency of the pulse, even when the bowels are only slightly acted on.

General Action.—The root has long been used by the American Indians as an **emetic** and **anthelmintic.** From its supposed resemblance to calomel, it has been styled vegetable mercury. The resin produces its effects whether it is swallowed or injected hypodermically. The **cholagogue** actions of podophyllin have been investigated by Professor Rutherford of Edinburgh. Moderate doses introduced into the duodenum, whether of fasting or recently fed dogs, become absorbed, and increase secretion both of the fluid and solid constituents of the bile. He believes that it directly stimulates the hepatic cells, but does not increase the blood supply of the liver. Excessive doses are imperfectly absorbed, and do not increase biliary secretion. This special stimulation of the liver by small, but not by large doses, is also observed in the case of aloes, rhubarb, colchicum, croton oil, and other cholagogues. In common with other purgatives, acting upon the small intestines, it sweeps out food, which, when absorbed, stimulates the liver; while, moreover it carries away bile poured into the canal, and thus prevents its reabsorption.

In the domestic animals the **cathartic effects** of podophyllin are produced tardily and not very certainly; while even moderate doses are apt to cause nausea and griping. The manner in which the force and frequency of the pulse, are reduced, requires investigation.

The late Dr F. G. Anstie made, in 1863, a series of experiments with alcoholic solutions containing one to two grains podophyllin, which he injected into the peritoneum of dogs, cats, and rats; and produced in ten to fifteen hours, vomiting, bloody fæces, hurried shallow breathing, and death from exhaustion.—(*Medical Times and Gazette,* March and May 1863).

Mr D. B. Howell, of Reading, reports podophyllin to be a prompt and effectual purge for dogs, acting usually in four hours. One drachm to one drachm and a half, with two drachms ginger, he states, moved the bowels of horses in six or eight hours. Not only was the action prompt and certain, but there was no griping, even when the resin was given without

preparation, and water allowed *ad libitum*. About a drachm is recorded to have purged a cow in nine hours (*Veterinarian*, August, 1865).

I have not been able to obtain such marked results. I have repeatedly given healthy **horses**, prepared by mashes, two drachms podophyllin without perceiving any increased action of the bowels. Two drachms, even when united with one or two drachms of aloes, added, to determine, if possible, its action on the bowels, produced only slight softening of the dung, such as might be expected from the aloes alone. To three healthy **shorthorn cows** I gave three drachms each, and to another cow half an ounce, without observing any laxative effect. One grain podophyllin, given in pill or bolted in a piece of meat by English **terriers** weighing about twenty pounds, produced no notable effect upon the bowels; while two grains acted as a gentle laxative, but only after six or eight hours.

Mr Thomas A. Dollar, of New Bond Street, London, has used the drug frequently, both in **horses** and **dogs**, and has kindly placed at my disposal his notes of the following cases:—

A thorough-bred horse, well prepared by mashes, had two drachms podophyllin without its producing the slighest purgative effect. Two days later he again received two drachms, with a drachm of aloes, still without any noticeable action on the bowels. Four hours after the second dose, the pulse, however, was observed to have fallen from 44 to 34 beats per minute. During three days this horse ate nothing but bran; getting tired of this, he had for two days hay and a little corn; for twenty-four hours he was again restricted to bran mashes, and then received two drachms each of podophyllin and aloes, which, even after this careful preparation, only produced slight laxative effects.

To a well-bred hunter, nearly sixteen hands high, under treatment for injury of the psoæ muscles, and fed for twenty-four hours on bran, Mr Dollar administered two drachms podophyllin in a ball, and two ounces Epsom salt in solution. Scarcely any perceptible action was observed on the bowels; and two days later two drachms podophyllin and one drachm calomel was given, also without purgative effect, but with a

reduction, as in the previous case, of nearly ten beats per minute on the pulse.

A powerful cart-horse, under treatment for sand-crack, and previously restricted for twenty-four hours to a mash diet, got four drachms podophyllin in a ball. Although no purgation followed, there was much nausea, and in two hours the pulse became soft and somewhat weakened, fell from 36 to 24 beats per minute, and did not recover its natural force or number until next day. The appetite continued impaired for a week.

A thorough-bred mare, 14½ hands, under treatment for abscess from speedy cut, was placed on mash diet for twenty-four hours, and then received two drachms podophyllin in a ball, but showed no increased action of the bowels. For four consecutive days the mashes were continued, and two drachms of the drug repeated daily until ten drachms had been taken, still without any purgative effect. The pulse, however, which at first was 44, had gradually fallen a few beats daily, until on the fifth day it was 30. By the end of the experiment, the coat stared, all food was refused during nearly two days, and a fortnight elapsed before the mare recovered her usual appetite and appearance.

A Scotch terrier, eight months old, received half a grain podophyllin in a pill, without any apparent effect; and on the following day a grain, which in the course of an hour caused nausea and vomiting: considerable dulness remained for twenty-four hours.

A bull terrier bitch, 36 lbs. weight, received four grains in a pill, without showing any notable symptoms; and on the following day had a further dose of six grains, which in twelve hours produced great uneasiness and griping, and gentle catharsis. During the two following days the bitch refused food, and for a week continued dull and listless.

A French poodle, suffering from mange and constipation, had a pill, containing two grains podophyllin, half a grain calomel, and 20 grains jalap. No effect was observable at the end of twelve hours, when the dose was repeated, and after eight hours the dog was briskly purged. Half the above dose was repeated every second day for a fortnight, with the result

of gently moving the bowels. In all these cases the pulse was reduced in number and in strength; the urinary secretion was unchanged; the fæces were little altered in colour.

MEDICINAL USES.—Mr Dollar's experiments demonstrate that for veterinary patients podophyllin resin is a tardy and uncertain purgative, especially when used alone. In combination however with aloes, jalap, or calomel, it relieves **torpidity or congestion of the liver**; while its nauseant and sedative effects may occasionally be used for **lowering cardiac action** in acute lymphangitis, rheumatism, and other inflammatory disorders in robust patients. Although possessed of **vermifuge** powers, depending upon its purgative effect, it does not appear to have any special vermicide action. For human patients it is prescribed both in this country and America in habitual constipation, congested states of the liver, in some forms of sick headache, and in smaller doses as an alterative in skin diseases and rheumatism. Half a grain to a grain of the resin slowly empties the human bowels.

DOSES, ETC.—For cholagogue or sedative purposes, horses and cattle take ʒj. to ʒij. of podophyllin resin united with aloes or calomel, with nitre or Epsom salt. For dogs, gr. j. to grs. ij. with calomel gr. j. to grs. ij., may be conjoined with half a dose of jalap or of oil. Nausea and griping are obviated by admixture of ginger or other carminative, and of henbane or cannabis indica.

POTASSIUM AND ITS MEDICINAL COMPOUNDS.

Potassium salts are obtained from (1) carnallite, a chloride of potassium and magnesium ($KCl. MgCl_2. 6H_2O$) overlying the rocksalt in the mines of Stassfurt in Saxony; (2) from the crude potashes got from wood ashes; and (3) from the argol deposited during the fermentation of wine (p. 549). Most are soluble in water. They are identified in solution by their negative reaction with the several group tests for the metals, while moderately strong neutral solutions rather slowly form, with sodium hydrogen tartrate, a white crystalline precipitate ($KHC_4H_4O_6$), soluble in hydrochloric acid and in caustic potash. Evaporated to dryness, and ignited with alcohol,

they produce a distinctive violet-coloured flame, which gives on the spectrum two lines—one intense on the red, the other transient on the violet.

ACTIONS AND USES.—Potassium salts are **protoplasmic poisons,** and when applied sufficiently long, or in sufficiently strong solutions, destroy muscles, nerve-centres, and nerves. They **resemble salts of sodium and of lithium.** They are more soluble, more readily absorbed and diffused, but are also more quickly excreted than sodium salts. As muscle-irritants, they are more powerful. They paralyse nerve-centres usually after transitory excitement. They paralyse the heart when injected into the veins, but not when swallowed. On the circulation, their action somewhat resembles that of digitalis. Large doses cause a rapid fall of blood-pressure and pulse rate. Small doses, after a slight fall, raise both pressure and pulse rate, depending, it is believed, on constriction of the arterioles. They cause death, preceded by convulsions, and depending on stoppage of the heart (*Brunton*).

They **occur** in **land plants and animals,** and hence are necessary constituents of the food of both. In animal bodies they occur chiefly in the solid textures, while the corresponding sodium salts are more abundant in the fluids. Dr Ringer teaches that they have a high diffusive power, rapidly enter the blood, increase its alkalinity, promote oxidation and tissue metamorphosis, are solvents of albuminoids, and in one or other of these ways help to abate febrile and inflammatory attacks. They are **alteratives** and antidotes to poisoning by barium salts. They are quickly **excreted,** mainly by the kidneys, increase chiefly the watery parts of the urine, neutralise its acidity, and often exert soothing effects on the urino-genital mucous surfaces. In febrile complaints they are eliminated in larger amount than soda salts, which are excreted more largely during convalescence.

Recollection of the uses of the several potassium salts is facilitated by dividing them into **three groups**:—1st, Salts which are corrosive, antacid, antilithic, and alterative—such as the hydrate and carbonates. The salts of the weaker vegetable acids—tartrates and citrates—in their passage through the body are decomposed into carbonates, rendering the urine

alkaline. 2nd, Salts which are cathartic, diuretic, alterative, febrifuge, and refrigerant—such as the sulphate, acetate, tartrate, nitrate, chlorate, and permanganate. 3rd, Salts which exhibit prominently the actions of their acid, or salt radical constituent—such as potassium sulphuretum, iodide, bromide, and cyanide.

POTASSIUM HYDRATE. Potassa caustica. Potassa fusa. Potassic hydrate. Hydrate of potash. Caustic potash. K HO.

POTASSIUM HYDRATE SOLUTION. Liquor Potassæ. Caustic potash solution.

Crude **potashes,** obtained by dissolving the ashes of land plants, when calcined, lose some of their organic impurities, and are known as **pearl ashes.** When this still impure potassium carbonate is boiled with calcium hydrate, Ca CO_3 is precipitated, and **potassium hydrate** (K HO) remains in solution, twenty-seven grains being present in the fluid ounce of the **liquor potassæ.** This is a dense, oily-like fluid, of specific gravity 1·058, colourless and odourless, with an intensely acrid, alkaline, soapy taste, and an alkaline reaction on colouring matter. Boiled with oils and fats, it forms soaps; mixed with acids, it forms neutral, soluble, crystallisable salts. It softens and dissolves soft animal and vegetable tissues. Although little used in medicine, it is of much importance in chemistry, pharmacy, and other arts. When boiled until a drop removed on a stirrer becomes hard on cooling, and poured into pencil-like moulds, there are formed the grey or white deliquescent, hard, crystalline sticks of **caustic potash.**

ACTIONS AND USES.—Full doses of potassium hydrate, whether solid or in concentrated solution, are irritant, corrosive, and cardiac sedatives. Medicinal doses are antacid, alterative, febrifuge, and diuretic. Externally, they are used as active penetrating caustics.

TOXIC EFFECTS.—Large doses, when swallowed, soften, corrode, and inflame the œsophagus and stomach, sometimes so severely as to cause perforation; while great depression accompanies the local lesions. Hertwig records that two

drachms caustic potash, dissolved in six ounces water, killed a horse, with symptoms of colic, in thirty-two hours. Orfila gave a dog thirty-two grains, which caused violent vomiting, restlessness, and death in three days. **Post-mortem** discovered the mucous coat of the œsophagus and stomach red and black from extravasation of blood, with a perforation measuring three-quarters of an inch near the pylorus, surrounded by a hard thickened margin (*Christison On Poisons*). The blood is dark-coloured and generally fluid, owing to the solvent action of the alkali. Smaller or more diluted doses gradually impair digestion and assimilation, and destroy life by inanition. The **antidotes** are diluted acids, which form mild salts, and oils which produce soaps—themselves of service as demulcents, and in men and dogs as auxiliary emetics. Irritation is also relieved by milk, gruel, or other demulcents.

Medicinal Uses.—Dr John Shortt, of Madras, used the diluted solution both internally and externally as an **antidote for the poison of snakes** and vipers. Half a drachm, repeated twice daily, has been prescribed for feeding sheep affected with **vesical and urethral calculi**; but the carbonate is milder and equally effectual. It is occasionally added to cough mixtures when bronchial secretion is scanty.

Caustic potash is used for eradicating **warts and fungous growths,** making issues, and cauterising poisoned wounds. On account of its deliquescence and liability to spread and penetrate, it must, however, be applied cautiously, and any excess of alkali neutralised by subsequent washing with a weak acid. Mixed with lime, constituting **Vienna paste,** it is less deliquescent, and hence more safe and manageable.

Potassium Carbonate. Potassii Carbonas. Potassic Carbonate. Carbonate of Potash ($K_2 CO_3$).

Potassium Bicarbonate. Potassii Bicarbonas. Hydropotassium Carbonate ($KH CO_3$).

Potassium carbonates are got by several processes—(1) the American **pot or wood ashes,** in their partially purified condition of **pearl ashes,** contain about 80 per cent. of potassium carbonate, with 20 per cent. of potassium sulphate and chloride,

which, being less soluble, are got rid of by dissolving the pearl ashes, with brisk agitation, in an equal weight of water, pouring off the solution, and evaporating it to dryness. (2) From the sulphate they are obtained by a process similar to that followed in making sodium carbonate. (3) A pure carbonate is got by burning potassium tartrate ($KH\ C_4\ H_4\ O_6$) with carbon.

The carbonate occurs in crystals, as a crystalline powder, but more generally in grains. It is white, opaque, and inodorous, with a strong alkaline taste, and an alkaline reaction on test-paper. It is soluble in its own weight of water at 60° F., deliquesces rapidly in the air; but as it gradually absorbs carbonic acid, it again slowly dries up. Exposed to a red heat, it loses water of crystallisation to the amount of 16 per cent.

Potassium bicarbonate, or acid carbonate of potash, is prepared by passing carbonic acid gas through a strong aqueous solution of the neutral carbonate. It occurs in transparent, colourless, right rhombic prisms; has a mild, saline, and slightly alkaline taste; dissolves in about four times its weight of water at 60° F.; when heated to redness, it gives off carbonic acid and water, and is converted into the neutral carbonate. It is **distinguished** from the neutral carbonate by its milder non-acrid taste, its lesser solubility in water, its more abundant effervescence with hydrochloric acid, its not deliquescing when exposed to the air, and its giving, in diluted solution, no precipitate with Epsom salt or corrosive sublimate.

ACTIONS AND USES.—The two carbonates differ only in the degree of their action. Both resemble the hydrate, but have their activity tempered and diminished by combination with carbonic acid. The **neutral carbonate**, in concentrated solution, has much of the corrosiveness of the hydrate. Two drachms given to a dog caused vomiting, great agony, and death in twenty-five minutes (*Orfila*). Its antidotes are the same as those of caustic potash. The **bicarbonate** has no irritant or corrosive action, is preferable as an antacid, and in virtue of its liberating carbonic acid exerts soothing effects on the irritable gastric membrane. Both carbonates are antacid, antidotes for overdoses of acids, and are alterative and diuretic.

MEDICINAL USES.—Potassium bicarbonate is occasionally substituted for sodium bicarbonate to aid the **emulsionising of fats,** and, on account of the evolution of carbonic acid, to soothe the irritable stomach. Prescribed, usually with a bitter, and before meals, it **increases secretion of gastric juice;** given after meals, it **neutralises excess of acid,** resulting from undue secretion of gastric fluid or from such acid fermentation of starch, sugar, or fats, as occurs among carelessly fed calves. The precise pathology of **rheumatism** is not very clearly made out; but small repeated doses of alkaline bicarbonates sometimes prove beneficial, apparently by promoting metamorphosis of albuminoids, neutralising excess of sacro-lactic acid, and encouraging the action of the kidneys. In such cases it is conjoined according to circumstances with oil of turpentine, salicylic acid, quinine, or potassium iodide. Similar **antacid** treatment is also successful in nettle rash, lichen, and occasionally in eczema; a diluted solution being also applied externally to raw, weeping, painful, or itching surfaces. Potassium bicarbonate is specially suitable for preventing or removing **uric acid deposits,** which occasionally occur in overfed dogs; and the potassium is much more soluble than the sodium urate. **Calculi** and **deposits** largely made up of ammonio-magnesian-phosphate, occur in the bladder and urethra of highly-fed rams and wethers. In the treatment of these cases, Mr Litt of Shrewsbury, with exercise and laxative diet, recommends castor oil, f ℥ij. to f ℥viij., with belladonna extract, grs. viij. to grs. xvj., followed by potassium bicarbonate, ʒss. to ʒj., repeated thrice daily, freely dissolved in water or other diluents. **As diuretics,** the carbonates are less certain than the nitrate or acetate. Professor Walley finds that both the carbonates and hydrate, as well as the corresponding sodium salts, increase the activity of aconite when given along with it.

Externally the carbonates are applied as stimulants and detergents. Used with soap and hot water, they soften and remove skin incrustation, whether consisting of sebaceous matters, thickened scales, abnormal discharges, or dirt. Diluted with 80 to 100 parts of water, along with a little glycerin, the bicarbonate forms a soothing dressing for the earlier weeping

stages of eczema, especially in dogs, and proves a serviceable injection in leucorrhœa in all patients. In the Cape Colony, a ley made from wood ashes is used successfully as a remedy for scab, either alone or mixed with sulphur.

Doses, etc.—Of either carbonate, horses and cattle take ℥ ss. to ℥ j.; sheep aad pigs, ʒ ss. to ʒ j.; dogs, grs. x. to grs. xl. repeated several times a day, liberally diluted with water. For stimulating gastric secretions, they are given half an hour before eating; but in most dyspeptic cases acids are more permanently effectual.

Potassium Sulphuretum. Potassa Sulphurata. Sulphurated Potash. Potassium Sulphide. A mixture of salts of potassium of which the chief is sulphide. (B. P.)

One part of sulphur and two of potassium carbonate are mixed and heated until fusion occurs, poured on a stone slab and cooled. There is produced a liver-brown, bitter, acrid, alkaline substance, which is odourless when dry, but when moistened smells of hydrogen sulphide. It readily disolves in water, forming a yellow solution.

Actions and Uses.—Large doses are irritant and narcotic. Medicinal doses are laxative, stimulate the secretions of the skin and respiratory mucous membrane, and are alterative. Externally, it is occasionally applied as a substitute for sulphur in the treatment of chronic skin diseases.

Toxic Effects.—Two ounces are stated to have destroyed a horse (*Bouchardat*); six drachms and a half, introduced into the stomach of a dog, and retained by ligature on the œsophagus, occasioned death with tetanic symptoms in seven minutes; a drachm and a half in small fragments, introduced into the subcutaneous areolar tissue of dogs, caused extensive inflammation, coma, and death in thirteen hours (*Christison*). It appears to act much in the same manner as sulphuretted hydrogen, reducing and decomposing the hæmoglobin of the blood, and causing nervous and muscular paralysis.

Medicinal Uses.—It has been used in chronic cough, rheumatism, and skin diseases, in doses of ʒ i. to ʒ iij., for horses and cattle, and grs. ij. to grs. x. for dogs. Like sodium and

calcium sulphides, when given several times daily, it hastens maturation of indolent boils and abscesses, and prevents further formation of pus (*Ringer*). Once a panacea for all kinds of poisoning, it is now used only in poisoning by lead, which it converts into a black insoluble and almost inert sulphide.

POTASSIUM SULPHATE. Potassii Sulphas. Sulphate of Potash. (K_2SO_4).

POTASSIUM BISULPHATE. Hydropotassium Sulphate. Bisulphate of Potash. $(KH\ SO_4)$

Potassium sulphate is got from certain salt mines, and from the mineral kanite, which is a double sulphate of potassium and magnesium. It occurs in transparent, colourless rhombic prisms, which have a sharp, saline, bitter taste, are hard and difficult to powder, and dissolve in four parts of water at 212° F, and in sixteen parts at 60° F.

The bisulphate is the residue in the preparation of nitric acid from nitre and sulphuric acid. It is colourless, crystalline, and soluble, with an acid taste, and an acid reaction on colouring matter. It is distinguished from the neutral sulphate by its small flat prisms, its greater fusibility and solubility in water, its acid taste and reaction, and its decomposing carbonates with effervescence—a property which has led to its being occasionally substituted for tartaric acid in making effervescent powders.

ACTIONS AND USES.—Both sulphates are cathartic, cholagogue, and diuretic. As cathartics, they are not so prompt and certain as sodium and magnesium sulphates; while as diuretics, they are less active than potassium nitrate or acetate. Professor Rutherford found that potassium sulphate has a distinct stimulant effect on the liver, shared by sodium sulphate, but not by magnesium sulphate. On account of its hardness and inaptness to absorb moisture, it is used for facilitating trituration of such tough vegetable substances as opium, ipecacuan and jalap.

POTASSIUM IODIDE. Potassii Iodidum. Potassic Iodide. Hydriodate of Potash. (KI).

The iodide is **prepared** by slowly adding iodine to a solution

of potash, until it acquires a brown colour. The solution containing potassium iodide and iodate, is evaporated to dryness, and the residue, mixed with one tenth of its weight of powdered charcoal, is fused in a red hot crucible, when the iodide is converted into iodate. The fused mass is dissolved in hot water, filtered and evaporated, until a film appears on the surface, when it is set aside to crystallise.

The subjoined equations indicate the two stages in the process :—

Potassium Hydrate.		Iodine.		Potass. Iodide.		Potass. Iodate.		Water.
$6\ KHO.$	$+$	$6\ I$	$=$	$5\ KI.$	$+$	$KIO_3.$	$+$	$3\ H_2O.$

Potassium Iodate.		Charcoal.		Potassium Iodide.		Carbonic Oxide.
$KIO_3.$	$+$	C_3	$=$	$KI.$	$+$	$3\ CO.$

Properties.—Cubical crystals, colourless, generally opaque, with a faint odour of iodine, a saline taste, decrepitating when heated, fusing at a red heat, at a higher temperature volatilising unchanged, dissolving in two-thirds of its weight of water at 60° F., and in half its weight of boiling spirit. Both aqueous and alcoholic solutions dissolve iodine freely, and are hence useful vehicles for its exhibition.

Actions and Uses.—Potassium iodide closely resembles iodine (p. 410), but is less powerful, and devoid of local irritant action. It stimulates the lymphatic system. Medicinal doses are antiseptic, alterative, deobstruent, and slightly diuretic.

It is readily soluble, and is **quickly absorbed**; in the tissues, it **undergoes decomposition**; the iodine liberated apparently combines with albuminoids, and **acts** specially **on lymphatic glands and vessels,** hastening metabolism, and promoting absorption. It is doubtless in this way that it also unites with lead and mercury deposited in the tissues, renders them soluble, carries them into the circulation, and causes their elimination. It is **excreted** by the mucous and skin surfaces, and by the kidneys.

Toxic Effects.—**Dogs** receiving two to three drachms dissolved in water, vomited, shewed great depression, and died in a few days; rabbits were similarly affected by one drachm; three drachms injected beneath the skin of the back of a dog caused extensive subcutaneous inflammation, and death in

three days. Iodine was detected after death in the blood and urine, in the brain and spinal cord, in most of the internal organs, and even in the muscles and bones (*Cogswell*). Maillet (quoted by Tabourin) states that two or three drachms given to **horses** act as an irritant poison, and that three or four drachms cause fatal intestinal hæmorrhage. But this must be a mistake. I have many times given horses and cattle half an ounce to an ounce without any other effect than slight diuresis and occasional catharsis. Full doses continued twice daily for a week or longer, do not produce in horses iodism such as occasionally follows its use in human patients (p. 412).

Medicinal Uses.—It is given either alone or with iodine to **promote absorption** of deposits, as in lymphangitis in horses, enlarged glands, and lung consolidations in all animals. For the dispersion of such deposits, full doses are generally prescribed twice or thrice daily for a fortnight; and where they are superficial, iodine and soap liniments may also be rubbed in externally. **Rheumatism** and **eczema** are frequently benefited by a ten days' course of potassium iodide. In chronic **poisoning with lead or mercury,** it removes those minerals from the tissues and from the body. In **bronchitis,** where the membrane is dry, potassium iodide is usefully conjoined with ammonia acetate solution, and such a prescription promotes mucous secretion. In the earlier convalescent stages of bronchitis and pneumonia, as already indicated, it helps to remove exudate, and is conjoined with alcoholic and other stimulants. In cases of **roaring** in horses, Professor Robertson used it with arsenic.

Externally, usually conjoined with soap liniment and laudanum, it is applied to painful, swollen, rheumatic joints, and to inflamed udders in cows and ewes. It is much used for increasing the solubility of iodine, both in water and alcohol.

Doses, etc.—Horses and cattle take ʒij. to ʒvj.; sheep and pigs, grs. xx. to grs. lx.; dogs, grs. v. to grs. xv.; repeated two or three times a day, and given either in bolus or solution, in water or spirit Dr Lauder Brunton suggests that its effects are increased when it is given with common salt, more iodine being thus liberated (*The Practitioner*, September 1876).

POTASSIUM BROMIDE. Bromide of Potassium. K Br.

The bromide is prepared from the mother-liquors of the salt-works at Stassfurt, and from salt-springs in the United States (*Bloxam*). When purified, it occurs in colourless cubical crystals, soluble in water, but insoluble in spirit, odourless, but with a pungent saline taste. When chlorine is added to the aqueous solution, bromine is liberated, identified by its distinctive yellow-brown colour, and, when in considerable amount, by its suffocating odour.

ACTIONS AND USES.—It is a **cerebro-spinal sedative.** Full repeated doses produce anæmia of the brain and cord, impair reflex action, and subsequently cerebral function, and partially paralyse the hind limbs. Pulse respiration and arterial tension are lowered. It is rapidly **excreted** unchanged in the urine. In human patients it is prescribed to control reflex and cerebral excitability, to diminish spasm, and produce sleep.

In the lower animals it abates irritability or excitement, whether resulting from functional disorder, weakness, or shock, and whether manifested in restlessness or convulsions. In such cases it is conjoined, according to circumstances, with alcohol, chloral, or opium. It quiets irritability in many cases of tetanus in horses. **In dogs** it wards off or abates the severity of epileptic convulsions, a dose being given an hour before the recurring seizure. The bromides appear to exert, in these cases, a palliative rather than a curative effect. They **render the cerebral centres less sensitive to disturbing conditions.** They are serviceable in chorea and some cases of asthma. They do not possess the deobstruent properties of iodine. Brown-Séquard conjoins the bromides of potassium and ammonium, both of which are more active than that of sodium, and advises their being intermitted after a week, but resumed again in a few days.

DOSES, ETC.—Horses and cattle, ℥ss. to ℥j.; dogs, grs. v. to grs. xx., either of the potassium or mixed bromides, given in pill or solution, prescribed with hypnotics or anodynes. Even in full repeated doses, they cause no permanent or dangerous toxic effects, may safely be repeated every two hours, and may be conveniently given in the drinking water.

Potassium Nitrate. Potassii Nitras. Nitrate of Potash. Nitre. Saltpetre. KNO_3.

In the East Indies, Persia, Egypt, Spain, and other dry climates, a brown incrustation, consisting largely of nitre, covers considerable tracts of country. Nitric acid is formed by oxidation of the ammonia alike of the soil and atmosphere, and also by direct union of the nitrogen and oxygen of the air under influence of electricity. Potash salts are liberated from disintegration of felspar and mica rocks and from plant remains. The resulting saline efflorescence, consisting of sodium chloride and sulphate, and potassium and calcium nitrates, is gathered towards the end of summer; in India, about November. It is dissolved in water, and mixed with impure potassium carbonate; the insoluble calcium carbonate is allowed to settle, and the potassium nitrate poured off in solution, and pnrified by repeated solution and crystallisation. In France and other continental countries, nitre for gunpowder and other purposes is prepared artificially by collecting into large heaps animal and vegetable refuse, with old plaster and other calcareous matters. The heaps are sheltered from rain, but freely exposed to the air, frequently watered with urine, and occasionally turned. After about two years, the whole is lixiviated, and purified by a process similar to that followed with the natural nitre. By decomposing sodium nitrate with potassium chloride, nitre is also prepared.

Properties.—White, opaque, crystalline masses, or transparent, colourless, anhydrous, slender, six-sided prisms, with a sharp, cooling, saline taste, undergoing no alteration in the air, deflagrating when thrown on flame. It is soluble in $3\frac{1}{2}$ parts of cold water, and one-third of its weight of boiling water; during solution, much heat is abstracted; it is insoluble in alcohol. It attacks all oxidisable substances. Warmed in a test-tube, with sulphuric acid and copper filings, it evolves ruddy fumes of nitric peroxide; heated to fusion, the melted mass forms, on cooling, the hard, white, fibrous **sal-prunelle.** None of its common impurities interfere with its medicinal actions.

Actions and Uses.—Large doses are irritant and feebly

cathartic. Medicinal doses are antiseptic, alterative, febrifuge, and refrigerant. It is excreted from the bronchial glands, the skin and kidneys, increasing the secretions of these organs. Used externally, it is stimulant and refrigerant.

TOXIC EFFECTS.—Large doses cause, in man and carnivora, fatal gastro-enteritis, with vomiting, weakness, and arrest of circulation, partly depending on reflex action, partly on direct action on the heart. But although an ounce has proved fatal in human patients, very large doses are required to cause serious effects either in horses or cattle. Mr Morton gave a healthy **horse** 2 lbs., dissolved in 6 lbs. water, and found that it acted both on the kidneys and bowels, but that its effects ceased in twenty-four hours (*Veterinarian*, 1837). Moiroud, however, reports that a ½ lb. given to horses, and two or three drachms to dogs, inflame the alimentary canal and urinary organs, causing depression and death, usually within twenty-four hours. Several ounces usually purge horses and cattle, and cause vomiting in dogs, accompanied by irritation of the kidneys and bladder. Dr Paul Guttmann, experimenting chiefly upon dogs, states that poisonous doses paralyse the spinal cord, cause dyspnœa, and occasionally convulsions and muscular weakness, first overtaking the hind extremities; and lessen the frequency and force of the heart-beat, which in fatal cases ceases in diastole.

MEDICINAL USES.—It is soluble, diffusible, and **quickly enters the blood**; but its action on living blood and on tissue metamorphosis are not clearly explained. It **promotes bronchial, cutaneous, and urinary secretion,** and clinical experience accords it notable **alterative** and **febrifuge** properties. Veterinarians everywhere use it largely in the treatment of febrile and inflammatory complaints, both in horses and cattle. In conjunction with ammonium acetate solution, it is frequently prescribed in catarrhal and pectoral disorders, in which it has the two-fold advantage of promoting discharge from the dry respiratory membranes and abating fever. Mr Alexander Lockhart, of New York, and other American practitioners, give as much as two ounces, dissolved in a pint of water, repeated thrice daily, and assure me that it effectually abates fever and pain, and controls exudation in **laminitis,** which, owing to

careless feeding and long fasts, is still common in America. Repeated doses, conjoined with quinine, are given in **purpura.** It is serviceable in **rheumatism,** in which it seems to promote excretion, diminish oxidation, and allay fever; and in such cases it is frequently prescribed with the carbonate iodide or chlorate, or with salicylic acid. Most heavy draught horses, while living on hard food, on Saturday night have a mash containing an ounce of nitre, which helps to maintain bowels, kidneys, and skin in good order, and ward off attacks of swelled legs and weed, common when hard-worked horses have one or two idle days.

Nitre, when dissolving in water, abstracts heat, and is hence sometimes used externally as a **refrigerant**; its cooling effects are increased by admixture with sal-ammoniac. Five ounces each of nitre and sal-ammoniac, dissolved in sixteen of water, reduce the temperature from 50° F. to 10° F. (*Pereira*). For such refrigerant purposes, ice, however, is cheaper, and more convenient.

Doses, etc.—As a diuretic, horses take ℥ss. to ℥j.; cattle, ℥j. to ℥ij.; sheep, ʒj. to ʒij.; pigs, ʒss. to ʒj.; dogs, grs. x. to grs. xxx. Soap, resin, with other diuretics, and free solution in water, hasten and increase the action of nitre on the kidneys.

The **diuretic mass** of The Royal (Dick's) Veterinary College is thus made:—Take soap and nitre, of each lbs. ij.; resin, lbs. iij.; Venice turpentine, lbs. ij.; oil of turpentine, f℥viij. Melt the soap and resin over a slow fire; remove the mixture from the heat; and when it has somewhat cooled, stir in the other constituents. The dose of this mass is ℥ij. The balls are made up with a little linseed meal or flour.

As an **alterative and febrifuge,** nitre is given in about half the doses used to cause diuresis, is repeated several times a day, and is generally conjoined with other medicines. A sedative febrifuge and laxative ball for the horse is prepared with an ounce nitre, a drachm aloes, and 20 grains calomel. Where the horse has cold, fever, and impaired appetite, a useful draught is made with Epsom salt two ounces, and nitre, powdered gentian, and ammonia acetate solution, of each an ounce, dissolved in gruel or ale. Catarrhal symptoms and

sore-throat are relieved by four drachms nitre and one drachm each of ipecacuan, camphor, and belladonna extract, made into bolus, and repeated every two hours. An ounce each of potassium nitrate and carbonate, with two drachms iodide, are useful in rheumatism. Amongst **cattle** similar combinations are serviceable. For them a convenient alterative is made with two ounces each of nitre, sulphur, and ginger, given in treacle and water, or in ale.

For the **dog** a good febrifuge consists of 5 grains each of nitre and Dover's powder, and 1 grain calomel, either placed upon the tongue, bolted in a piece of meat, or made into pill with syrup, or with liquorice powder and water. Mr Mayhew recommends 3 to 8 grains nitre, 1 to 4 grains James's powder, and the same quantity of belladonna extract, made into pill with confection of roses. Cats take about half the doses requisite for dogs.

POTASSIUM CHLORATE. Potassæ Chloras. Chlorate of Potash. ($KClO_3$).

Chlorine gas, evolved from manganese black oxide and hydrochloric acid, is passed rapidly into a strong solution of potassium carbonate and calcium hydrate. The hypochlorate first formed is decomposed by the heat evolved. The mass, when charged with chlorine, as indicated by its acquiring a pink colour, is boiled, and the crystals formed in cooling are purified by re-solution in boiling water. They are colourless rhomboidal plates, have a cool saline taste, are soluble in 16 parts of cold water, and in 2 parts at 212° F. The salt readily parts with its oxygen; thrown on red-hot coal, it deflagrates; triturated with sulphur or phosphorus, it explodes. Explosive gases are also evolved when it is heated with sulphuric or hydrochloric acids. It is distinguished by its negative reaction with silver nitrate solution, by a crystal evolving oxygen when heated, and by the residue boiled with a few drops of water, giving, with silver nitrate, the white precipitate of chloride.

ACTIONS AND USES.—Potassium chlorate is antiseptic, alterative, sialogogue, and diuretic; used externally, it is antiseptic, mildly stimulant, and refrigerant. It is less soluble than sodium chlorate, which it closely resembles.

MEDICINAL USES.—Poisonous doses highly **oxidise the hæmoglobin** of the blood, converting it into methæmoglobin, which holds oxygen firmly, and thus interferes with the aeration of blood in the remote capillaries. Hæmaturia and asphyxial convulsions precede death. In this action it resembles the nitrites. A small quantity, mixed with recently drawn blood, increases its coagulability and keeping properties. Used as a wash or gargle, it **stimulates the salivary and buccal glands,** moistening the dry parched mouth. It **soothes and heals aphthous eruptions** and ulcerations of the mouth and throat, while in catarrh, sore-throat, and bronchitis it thins the secretions and promotes expectoration. It is readily absorbed, and in febrile and blood-poisoning cases is believed to **exert antiseptic effects,** depending upon its oxidising properties. But this explanation is not quite satisfactory, for it is excreted in great part unchanged, small doses being removed by the kidneys and larger by the bowels. Like other salines, in febrile and inflammatory cases, whether in horses or cattle, it is believed to lower pulse and temperature, clean the tongue, improve appetite, gently stimulate the bowels, and render their evacuations more natural and less coated with mucus. It is usually prescribed with Epsom salt, gentian, or ether. Hard-worked horses, **overdone or suffering from cold,** are usually benefited by half an ounce given night and morning, with gentian and ether. Mr Thomas A. Dollar, of New Bond Street, London, frequently administers it in such cases, and states that its use for a week or two sometimes appears to ward off attacks of farcy. In the **catarrhal epizootics** of horses, Principal Robertson ordered it with sweet spirit of nitre and camphor. In the treatment of **purpura,** Professor Williams prescribes it usually with iron salts, believes that it increases—as it does outside the body—the coagulability of blood liable to extravasation, uses an ounce daily, divided into two or three doses, but finds that even less doses then suffice.

Solutions of 6 to 20 grains to the ounce of water are used as **antiseptic stimulants** for unhealthy wounds.

DOSES, ETC.—Horses take ℥j. to ℥iv.; cattle, ℥ij. to ℥vj.; sheep and pigs, grs. xx. to grs. lx.; dogs, grs. v. to grs. xv., repeated two or three times daily, given either in bolus or

solution, alone, or conjoined with bitters, tonics, or stimulants. Most horses, of their own accord, will take an ounce daily, dissolved in water or gruel. As a soothing electuary for sore-throat, it is conjoined with camphor, belladonna extract, and treacle.

POTASSIUM PERMANGANATE. Potassii Permanganas. Condy's red Fluid. ($KMnO_4$, or $K_2O.\ Mn_2O_7$).

When manganese black di-or-peroxide (MnO_2) is fused with potassium hydrate a green mass, or, with addition of water, a green solution, of **potassium manganate** ($K_2\ Mn\ O_4$) is formed. Sodium and potassium manganates in solution constitute Condy's green disinfecting fluid.

Potassium permanganate is prepared by fusing 4 parts manganese dioxide, 5 parts potassium hydrate, and 3½ parts potassium chlorate, which readily parts with its oxygen, producing the permanganate ($K\ Mn\ O_4$), which can be got in dark purple slender prisms. It is without colour, but has a sweet astringent disagreeable taste. It is readily soluble in cold water, producing a deep-red solution. So readily does it part with oxygen, that when mixed with such easily oxidised substances as sugar or glycerin, it takes fire or explodes spontaneously. The solution also readily evolves oxygen, and hence is an effectual bleacher and deodoriser. **Condy's red disinfecting fluid** is a mixture of potassium and sodium permanganates, and is about half the strength of the B. P. liquor potassi permanganas, which contains about one per cent. of the salt.

ACTIONS AND USES.—The manganates, and more notably the permanganates, in virtue of their powerful oxidising effects, are used as **deodorisers,** and also as mild **topical stimulants.** Their power of breaking up various unstable organic substances is strikingly illustrated when they are mixed with the cobra poison, which thus treated loses its deadly power, and may with impunity be injected subcutaneously. When an animal however, has been bitten by a cobra, the permanganate solution, hypodermically injected, appears to be decomposed before it comes into contact with the poison, and has no antidotal effect.

When swallowed, it does not seem to exert the alterative or febrifuge effects of the nitrate or chlorate.

Potassium permanganate, although it has not the antiseptic power of corrosive sublimate, effectually **destroys bacteria**, and Koch found that a 5 per cent. solution arrested development of the spores of anthrax soaked in it for one day. It is used to **deodorise and disinfect** badly smelling wounds, the nostrils in ozæna, the mouth in aphtha, the throat when ulcerated, the uterus in metritis, and in retention of the placenta; and also to cleanse the hands or instruments that have been in contact with decomposing or contagious matters.

Permanganate solutions, in the convenient form of Condy's fluid, are frequently placed in shallow vessels about buildings to be deodorised, or sacks, saturated with one part of Condy to 50 or 60 of water, are hung about. Odorous, or contagious particles, brought into immediate contact with the permanganate, are thus destroyed; but for thorough disinfection, such a non-volatile body cannot be depended upon like chlorine, sulphurous acid gas, or the volatile tar acids. More effectual results are obtained when the permanganates are brought into absolute contact with the injurious organic particles. Thus four ounces of Condy's red disinfecting fluid stirred amongst 100 gallons of stale-smelling, unsightly rain water, left in a foul cistern, usually precipitates all impurities, and after some hours the clarified water becomes sweet and fit for use. The rapidity with which a known quantity of the permanganate solution parts with oxygen, and loses its purple or pink colour, is a handy test of the amount of **organic contamination** in water, other fluids, or even in air, experimented with.

DOSES, ETC.—Potassium permanganate has been given to horses and cattle as an alterative and febrifuge in drachm doses; but observation does not justify its preference to the nitrate or chlorate. For antiseptic and deodorant purposes, Condy's red fluid is dissolved in 50 to 100 parts of water.

POTASSIUM ACETATE. Potassæ Acetas. Acetate of Potash. ($KC_2H_3O_2$ or $K\,CH_3CO_2$).

When potassium carbonate is neutralised by acetic acid,

the white asbestos-like, soluble, deliquescent acetate is produced. In its actions and uses it closely resembles the nitrate, effectually alkalinifies the blood and secretions; like other alkaline salts containing a vegetable acid, it is mainly converted in the system into a carbonate; and is chiefly excreted in the urine producing diuresis. The doses are the same as those of the nitrate.

POTASSIUM ACID TARTRATE. Potassæ Tartras Acida. Potassæ Bitartras. Acid Tartrate of Potash. Potassium Hydrogen Tartrate. Cream of Tartar. ($KHC_4H_4O_6$).

POTASSIUM TARTRATE. Potasii Tartras. ($K_2C_4H_4O_6.H_2O$).

The **crude tartar or argol,** obtained in an impure state from the interior of wine casks, when purified by solution and crystallisation, occurs in white, hard, crystalline masses, with a sharp acid taste. When administered it retains water with avidity; is slowly absorbed; although it does not cause intestinal irritation or peristalsis, doses of several ounces given to horses or cattle render the fæces fluid, and are **mildly laxative.** Lesser doses, like those of the alkaline salts of most organic acids, are converted in the body into the carbonate, and excreted mostly in the urine, causing **diuresis.**

The normal potassium tartrate is prepared by boiling, for a few minutes, about 1 part potassium carbonate and 2 parts potassium acid tartrate, cautiously adding, as required, a little either of the alkaline or acid salt, until the solution is neutral to test-paper, filtering, and crystallising. It occurs in small colourless four or six-sided prisms. It **resembles the acetate and nitrate**; in small doses is **diuretic,** in larger **purgative.** Professor Robertson used to recommend it with magnesium or sodium sulphate in anæmic young horses affected with congested liver.

PRUSSIC OR HYDROCYANIC ACID.

Acidum hydrocyanicum, HCN or HCy.

Prussic acid was so called from being first obtained from Prussian blue. Its title of hydrocyanic acid is derived from

its being composed of hydrogen and the compound radicle cyanogen. It is one of the products of the distillation of coal, and traces are found in imperfectly purified coal-gas. The leaves and kernels of various stone fruits of the apple and almond natural orders, when crushed and moistened, undergo a species of fermentation, their albuminoid emulsin decomposing the glucoside amygdalin, and producing hydrocyanic acid, a hydrocyanated oil, benzaldehyde, and glucose.

$$\underset{\text{Amygdalin.}}{C_{20}H_{27}NO_{11}} + \underset{\text{Water.}}{2H_2O} = \underset{\text{Prussic acid.}}{HCN.} + \underset{\text{Benzaldehyde.}}{C_7H_6O} + \underset{\text{Glucose.}}{2C_6H_{12}O_6.}$$

Medicinal hydrocyanic acid is prepared by slowly distilling dilute sulphuric acid with potassium ferrocyanide, which gives off half its cyanogen to unite with hydrogen, while the other half combines with the iron and half the potassium, forming the yellow potassium ferrous ferrocyanide, which becomes blue by oxidation. The process is represented by the following equation :—

$$\underset{\substack{\text{Potassium}\\\text{Ferrocyanide.}}}{2K_4FeCy_6} + \underset{\substack{\text{Sulphuric}\\\text{Acid.}}}{6H_2SO_4} = \underset{\substack{\text{Hydrocyanic}\\\text{Acid.}}}{6HCy.} + \underset{\substack{\text{Potassium Ferrous}\\\text{Ferrocyanide.}}}{K_2Fe_2Cy_6.} + \underset{\substack{\text{Potassium}\\\text{Acid Sulphate.}}}{6\,KHSO_4}$$

The medicinal acid, when freshly prepared, **contains 2 per cent.** of **anhydrous acid,** but on account of its volatility, it is apt to lose strength. This may in part be obviated by keeping it in well-corked bottles, tied over with some impervious covering, laid down inverted, and in a dark place. It is colourless, with a diffusible peculiar odour, allied to that of cherry laurel water and bitter almonds, but without ratafia aroma. Its specific gravity is ·997. It only slightly and transiently reddens litmus paper. Evaporated on a platinum capsule, it leaves no residue.

It is distinguished by the following **tests** :—(1) **Prussian blue** is produced when a slight excess of caustic potash is added, then a solution of mixed ferrous and ferric sulphate, and a sufficiency of hydrochloric acid to neutralise the potash. (2) **Silver cyanide** is precipitated by the addition of silver nitrate; it resembles the white silver chloride in being soluble in ammonia and in hot dilute nitric acid; but is insoluble in cold concentrated nitric acid, while it also differs from the chloride in evolving, when

heated, the heavy strong-smelling cyanogen gas, which if kindled, as it passes from a narrow tube, burns with a rose-coloured flame edged with green. (3) **A sulpho-cyanide is produced** by heating a cyanogen compound with ammonium sulphide previously boiled with sulphur, getting rid of the ammonium sulphide by evaporation, and adding ferric chloride, which develops a blood-red solution of ferric sulpho-cyanide, which is bleached by mercuric chloride.

Anhydrous hydrocyanic acid is obtained by cautiously distilling the medicinal acid, and collecting the vapour in a receiver kept cold by ice. It may also be got by passing dry sulphuretted hydrogen gas through a tube containing mercuric cyanide. It is a colourless, very volatile, inflammable liquid, with a specific gravity of ·7, and devoid of acidity. Alike in its gaseous and liquid form, it is a most active deadly poison.

Potassium ferrocyanide or yellow prussiate of potash, generally used for preparing prussic acid, is made by fusing azotised animal refuse, such as scrapings of hides, cuttings of hoofs and horns, in an iron retort with potassium carbonate and iron filings. The carbon and nitrogen of the organic matters at the high temperature, and in presence of the potassium salt, unite to form the volatile radical cyanogen (CN or Cy), which is fixed by the potassium, forming potassium cyanide (K Cy). But iron being also present, there is formed a double cyanide of iron and potassium, which crystallises in four-sided tubular yellow prisms, gives with iron protosalts a grey precipitate, speedily becoming blue from absorption of oxygen, and with iron persalts a deep Prussian blue at once. It is tetrabasic, with the formula $K_4 Fe Cy_6 . 3H_2O$. When chlorine is passed through a solution of this ferrocyanide, an equivalent of potassium is removed, and there is produced the **potassium ferricyanide** or red prussiate of potash, which crystallises in bold red right-rhombic prisms, is distinguished from the yellow prussiate by giving no precipitate, but only an olive-green colouration, with ferric salts, but a brilliant deep blue at once with ferrous salts. It is tribasic, and has the formula $K_3 Fe Cy_6$, or K_3 Fdcy.

In testing for prussic acid in complex liquids, such as the contents of the stomach, they are filtered, neutralised with sulphuric acid, cautiously distilled, and the clear liquid which comes first over is tested in the usual way. A simpler process is sometimes pursued ; a portion of the suspected fluid is placed in a porcelain crucible, a wide-mouthed bottle or beaker, a few drops of strong sulphuric acid are added, gently stirring with a glass rod. If needful, the vessel may be placed in a basin of warm water, but the acid added usually evolves heat sufficient to volatilise any prussic acid, which may be condensed on a watch-glass inverted over the crucible or bottle, and moistened with silver nitrate, when silver cyanide is produced. If the watch-glass be moistened with potash solution, and any prussic acid is given off, potassium cyanide is formed, detectable by adding to it a drop of any mixed ferrous and ferric salt, and then a drop of hydrochloric acid, when Prussian blue is developed. As hydrocyanic acid is readily volatilised and decomposed by many organic substances, it can seldom be detected in the bodies of animals poisoned by it, unless examination is made within four or five days after death. It sometimes disappears even in less time, especially if the body has been exposed to the weather.

ACTIONS AND USES.—Poisonous doses paralyse the cere-

bro-spinal axis, kill almost instantaneously by cardiac arrest, or somewhat less suddenly by respiratory arrest. Topically applied, it paralyses the ends of sensory nerves, and hence is used as a local anodyne for the relief of irritation, especially of the skin, stomach, and throat.

General Actions.—It stops protoplasmic movements both in plants and animals, kills infusoria, checks oxidation, and arrests fermentation. Applied locally, it **destroys tactile sensation,** from paralysis of sensory nerves. In dogs and other small animals, a single drop of anhydrous acid applied to an absorbing mucous surface, or injected subcutaneously, or into the veins, within a minute causes **cardiac arrest,** and a full dose of the medicinal acid frequently acts in much the same rapid manner. Potassium and other cyanides are active poisons; but the ferro-cyanides are insoluble, and greatly less active.

Toxic Effects.—The toxic action is believed in great part to depend upon the acid forming, with the hæmoglobin of the blood, a compound—**cyan-hæmoglobin**—which does not readily give up oxygen, and internal respiration is thus arrested. Where the fatal result is not immediate, the **poisoning is divisible into three stages**—(1) The brain is affected; there is giddiness, staggering movements, a few slow inspirations, followed by rapid expirations and irregular heart-action. (2) Convulsions, both tonic and clonic, appear, depending upon paralysis of the cerebro-spinal axis, and hence differing entirely from those of strychnine, which result from stimulation of the cerebro-spinal axis. (3) Coma, anæsthesia, and paralysis of voluntary muscles supervene, with weak cardiac and respiratory movements, and death from paralysis of the cardiac or respiratory centres.—(*Brunton*).

Horses are poisoned in one or two minutes by 10 to 20 minims of anhydrous acid injected hypodermically. Professor Colman gave an aged horse repeatedly, at intervals of several days, 1 to 3 drachms of acid, containing about 4 per cent. of anhydrous acid, and noted much excitement, the pulse raised to 100, and in one experiment to 160, laboured breathing and tetanic contraction of the muscles; but the effects gradually passed away. Six ounces of medicinal acid given to Womb-

well's old elephant, killed at Birmingham in 1855, caused only slightly laboured breathing.

Dogs, cats, and rabbits which had 1 to 4 drops of anhydrous acid placed on the tongue, or within the eyelids, in ten to thirty seconds made three or four hurried inspirations, a convulsive expiration, often a cry, had tetanic convulsions, and died in one to three minutes. Air saturated with the gas killed one dog in ten seconds, another in five, and a cat in two seconds. Guinea-pigs inhaling it for one second die in fifteen seconds. Strong rabbits inhaling it for three seconds die in thirty seconds; but frogs are less sensitive. Dogs and cats receiving 40 to 60 minims of the 2 per cent. acid were sometimes poisoned almost as rapidly as with the anhydrous. More frequently, however, life is prolonged for several minutes, and death is preceded by giddiness, impaired voluntary movement, dilatation of the pupil, a slight rise and subsequent fall of blood-pressure, slowing of the pulse, rapid failure of respiration, and tetanic convulsions. The heart continues to beat for several minutes after respiration has ceased. In experiments made by direction of the Messrs Young, of Leith, two ounces were found to cause rapid death of Greenland whales, when discharged by an ingenious device into the wound made by the harpoon. Direct application of the acid to the medulla of an alligator, which had been imperfectly affected by doses administered internally, caused a long, deep expiration, tetanic spasm of the respiratory muscles, and death.—(*Jones & Bartholow*).

Post-mortem discloses variable appearances. Animals dying almost instantaneously from cardiac arrest have the blood of an arterial hue, as if, from dilatation of the remote capillaries, it had passed through them without change. When the respiratory centre of the medulla has been paralysed, causing death somewhat more slowly by respiratory arrest, the appearances are those of suffocation. For some hours after death the blood remains fluid, of a blue colour, and occasionally evolves the peculiar odour of the acid.

Antidotes.—Prussic acid is usually so rapidly fatal that the animal is often dead before any remedial measures can be adopted; but so volatile is the poison, and so rapidly is it removed from the body, chiefly by the lungs, that if the animal

lives for half an hour it will generally recover. **Artificial respiration** sometimes saves animals that have had lethal doses. Hypodermic **injection of atropine sulphate** stimulates the cardiac and respiratory centres, and thus averts mortal paralysis. The cautious inhalation of ammonia is also recommended, and affusion alternately with cold and warm water is applied to the head and neck. The most effectual **chemical antidote** is a mixture of a ferrous and ferric salt, administered with magnesia or potassium carbonate, and forming the insoluble Prussian blue. But, to be effectual, the antidote must be swallowed before the rapidly acting poison is absorbed.

MEDICINAL USES.—By paralysing the ends of the sensory nerves, the acid **allays** the **irritation** of urticaria, prurigo, and other itching skin complaints. In like manner, it sometimes relieves gastrodynia and chronic vomiting, being conjoined in such cases with ice, bismuth, and morphine ; while in irritable conditions of the throat it is prescribed with cocaine, chlorodyne, morphine or atropine. For destroying the strongulus micrurus of calves, and soothing consequent irritation, Professor Williams prescribes ♏x. to ♏xx. of acid, conjoined with sodium carbonate and gentian.

DOSES, ETC.—Of the B. P. 2 per cent. acid, horses and cattle take ♏xx. to f℥i. ; sheep and pigs, ♏x. to ♏xx. ; dogs, ♏ij. to ♏v., given in water sweetened with syrup. As the soothing effects are transient, the suitable doses are repeated three or four times daily, and, until perfectly regulated, their effects must be carefully watched ; while, to prevent mistakes apt to occur with such a poisonous, colourless liquid, it is often made up with compound tincture of cardomoms. Used **externally,** it should be largely diluted with water ; and as it undergoes absorption, it must be cautiously applied, especially where the skin is broken.

QUASSIA WOOD.

QUASSIÆ LIGNUM. The chips, shavings, or raspings of the wood of Picræna excelsa. (B. P.) *Nat. Ord.*—Simarubaceæ.

The dense, tough, white quassia wood, the produce of a

handsome tree, is imported from Jamaica and other West India islands in billets one to two feet in length, and is met with in the shops in yellow-white chips or raspings. The wood of the Quassia amara from Surinam has similar properties, and is much used in France and Germany. Quassia has no odour, but a purely bitter taste dependent on about $\frac{1}{10}$th per cent. of a neutral crystalline principle **quassiin,** ($C_{10}H_{12}O_3$). It contains no tannin.

Actions and Uses.—Quassia is a bitter stomachic, tonic, and anthelmintic. It resembles gentian, calumba, and cinchona. It is prescribed for the several domestic animals in dyspepsia, loss of appetite, convalescence from debilitating disorders, and for the destruction of lumbrici and ascarides. For removing ascarides the infusion is used both by the mouth and rectum. It acts as a narcotic poison for flies and other insects, and is said also to kill fish. (*Royle's Mat. Med.*) For the destruction of flies the infusion is placed in shallow vessels about the premises.

Doses, etc.—The B. P. infusion, prepared by macerating 1 part of chips for an hour with 80 fluid parts cold water, is administered alone or with salines, acids, or iron salts, with which, unlike most vegetable bitters, it mixes without decomposition or discoloration. Of the infusion horses and cattle take f℥ij. to f℥iv.; sheep and pigs, fʒiv.; dogs, fʒj. Neither extract nor tincture is used by veterinarians.

RHUBARB ROOT.

Rhei Radix. The root, more or less deprived of its bark, sliced and dried, of Rheum palmatum, Rheum officinale, and probably other species. Collected and prepared in China and Thibet. (B. P.) *Nat. Ord.*—Polygonaceæ.

The perennial herbaceous plants grow on the hill ranges of the interior of China, Tartary, and Thibet; the roots after five years' growth are collected in summer; are cleaned, peeled, cut into trapezoidal, round, cylindrical, or flat reddish-yellow, pieces, and each piece is usually bored with a hole, through which a cord is run in order to dry it in the sun. The powder

is bright, has a strong peculiar aromatic odour, with a bitter astringent taste, and is gritty when chewed, owing to the presence of crystals of calcium oxalate. It is dissolved by ether, rectified, and proof spirit; and less readily by cold and hot water, forming with the latter an orange-coloured solution. The East Indian rhubarb is coarser aud less aromatic. **English rhubarb,** the produce of R. raponticum, generally cultivated for its familiar leaf-stalks, the pleasant acid taste of which is due to the presence of malic and oxalic acids, is grown extensively for its roots near Banbury, Oxfordshire, and is mixed with or substituted for the Chinese. But it is softer and more mucilaginous, has less aroma and grittiness, contains fewer crystals of calcium oxalate, and is deficient probably to the extent of one-third in purgative power.

Rhubarb contains (1) **Chrysophanic acid** in the proportion of about 2 per cent., extracted by ether or alcohol, insoluble in water, and occurring, as its name indicates, in brilliant yellow crystals. It appears to have tonic properties. (2) **Chrysophan,** a bitter soluble glucoside, which, when boiled with sulphuric or hydrochloric acid, splits into chrysophanic acid and sugar. (3) **Phaoretin,** and other resinous bodies, appear to confer the cathartic properties. (4) **Rheo-tannic acid** imparts astringency and some tonic effects. (5) **Mineral substances** are largely present, consisting chiefly of calcium oxalate.

Actions and Uses.—Rhubarb is stomachic, tonic, astringent, mildly cathartic and cholagogue. Small and repeated doses improve the appetite; correct slight gastric derangement; in virtue of their tannin, diminish secretion and peristalsis; by their chrysophanic acid impart to the fæces a yellow-brown hue, and may be detected in the blood, urine, and occasionally in the milk. Larger doses, in dogs and cats, as in human patients, are **mild cathartics,** stimulate the secretions and movements, especially of the stomach and small intestines, and increase secretion of bile. Even small doses insufficient to purge fasting dogs, or purging only very slightly, increase all the constituents of the bile (*Professor Rutherford*). In horses and cattle it has scarcely any purgative effect; a pound has been given to cattle without moving the bowels; whilst half a pound to a pound caused in the horse only slight laxative

effects after thirty-six hours (*Moiroud*). On skin or mucous surfaces it acts as a mild astringent.

DOSES, ETC.—**As a stomachic and tonic,** repeated several times a day, horses have ℥ j.; cattle, ℥ ij.; sheep, ʒ j; dogs and cats, grs. x. to grs. xxx. **As a laxative,** dogs take ʒ j. to ʒ iij., usually combined with one or two grains of calomel, or with twenty grains of jalap. Rhubarb is used in the forms of powder, infusion, or tincture. The compound powder, or **Gregory's mixture,** prepared by mixing thoroughly six parts magnesia, one part ginger, and two parts rhubarb—all in fine powder—is an excellent stomachic and antacid, and is given in doses twice as large as those of the simple rhubarb. In diarrhœa in calves and foals it exerts carminative, laxative, and subsequently astringent effects. When the bowels are persistently relaxed two drachms each of rhubarb and magnesia, with half a drachm of opium, may be given night and morning in well-boiled wheat-flour gruel, with one or two table-spoonfuls of spirits or sweet spirit of nitre. One-third or one-half this quantity answers for diarrhœa amongst lambs.

SALICYLIC ACID.

ACIDUM SALICYLICUM. Hydroxybenzoic Acid. ($HC_7H_5O_3$ or $C_6H_4.HO.CO_2H$.) A crystalline acid obtained by the combination of the elements of carbolic acid, with those of carbonic acid gas and subsequent purification, or from natural salicylates, such as the oils of winter-green (Gaultheria procumbens), and sweet birch (Betula lenta). B. P.

Salicylic acid was originally prepared from **Salicin** ($C_{13}H_{18}O_7$)—a crystalline glucoside obtained from willow and poplar barks by fusing them with caustic potash. It can also be extracted from the stems, leaves, and rhizomes of the garden and other violets. In these plants, and in the volatile oils of the winter-green, and various Spireas, it occurs as a methyl salicylate ($C_6H_4.HO.CO_2CH_3$). But the **commercial source is sodium phenol**, through which carbonic acid gas is passed for several hours. The mixture is raised to 482° F.; the residue is

dissolved in a limited quantity of water, and treated with hydrochloric acid, when salicylic acid is precipitated, and is subsequently crystallised.

PROPERTIES.—It occurs as a soft, light, colourless powder, consisting of minute acicular crystals; but it may be crystallised in bold four-sided prisms. It is odourless, but when inhaled irritates the nostrils. It has a taste at first sweet, but subsequently bitter. It is soluble in 500 to 700 parts of water, at 60° F.; is more readily soluble in hot water, alcohol, and ether; and its solubility is increased by admixture with sodium borate, or phosphate. It fuses at 311° F., volatilises without decomposition below 392° F., but above that is decomposed into phenol and carbonic acid gas. Iron perchloride solution produces a reddish violet colour, alike with the acid and its salts. Copper sulphate gives an emerald green colour.

ACTIONS AND USES.—Salicylic acid belongs to the benzene or aromatic series of carbon compounds (p. 269), and in chemical constitution and physiological action is nearly allied to benzoic acid. It is antiseptic and antipyretic, and is used especially in the treatment of rheumatism.

GENERAL ACTIONS.—Solutions consisting of 1 to 10 per cent., if mixed with fluids containing bacilli germs, prevent their development; a 2 per cent. solution **destroys bacteria**, and arrests the action of yeast and other ferments. It has about the same antiseptic power as benzoic, boric, or carbolic acids, but is not so effectual as chlorinated lime, sulphurous acid, or corrosive sublimate. Although not very soluble, both the acid and its salts are quickly absorbed and quickly excreted. Large doses enfeeble the circulation, lower blood-pressure, and fatally paralyse respiration. In healthy dogs and rabbits, as in man, it does not lower the temperature; but in such diseases as rheumatism, frequently repeated doses usually reduce abnormal temperature sometimes to the extent of several degrees. This effect probably results from a **germicide** action. Professor Rutherford found that both the acid and its soda salt, are **hepatic** but not intestinal **stimulants**; they render the bile more watery, and act like the allied benzoic acid. It is **excreted** in the perspiration, saliva, and urine, in which it appears as salicylates, and in combination with glycol as

salicyluric acid. It communicates to the urine a brown or green coloration, and retards its decomposition.

The acid is rather more active than salicin, and about twice as active as the sodum salicylate, which is devoid of antiseptic properties.

MEDICINAL USES.—The acid and its alkaline salts are frequently serviceable in arresting fermentative changes in **dyspepsia,** accompanied by acidity and flatulence, and in diarrhœa in young animals. **Rheumatism** in all classes of patients, whether acute or chronic, is frequently treated with salicylic acid, and salines; but it is difficult to allot to remedies thus conjoined their due share in the cure. Most practitioners agree with the late Professor Robertson, that the salicylic treatment does not control rheumatic attacks in horses and cattle, as effectually as in human patients. The most satisfactory results are obtained in the more acute cases, and where the joints are principally affected. Mr E. Price, Birmingham, prescribes for horses, 10 grs. repeated every two hours, gradually increased to a drachm, and reports the disappearance of the rheumatic pains in forty-eight hours (*Veterinarian*, February 1888). The explanation of the curative effects is not very evident, but they may result from the salicylic acid breaking up some of the irritant lactic acid products, which abound in rheumatism.

In typhoid, zymotic, and malarial fevers, it is not so effectual as quinine. Professor Robertson, however, recommended it in influenza accompanied with gastro-intestinal symptoms, and where hæmorrhagic effusions were suspected. Other practitioners testify to its value in purpura, and also in strangles. I have repeatedly used it, with apparent advantage, in metritis in ewes. Mr Dollar, of New Bond Street, London, and Mr I. Print of Clapham, have, without benefit, given drachm doses daily to horses affected by farcy and nasal gleet. Mr J. B. Gresswell recommends both the acid and the sodium salt in rheumatic arthritis and bad cases of foot-and-mouth disease in sheep (*Veterinary Pharmacology and Therapeutics*). It is generally serviceable in the rheumatic complaints of dogs.

In antiseptic surgery salicylic acid is sometimes substituted for carbolic acid. It resembles boric acid in being non-volatile and less irritant than carbolic acid. It is serviceable for

wounds where granulation and epithelial growth have been unduly checked by too free or prolonged use of irritant antiseptics. It sometimes abates the itching and discharge of eczema and psoriasis. It has been successfully employed in the treatment of open joints. An electuary made with borax spirit and glycerin is used in ulcerated and diphtheritic throats.

DOSES, ETC.—Horses and cattle take ʒj. to ʒij.; sheep and dogs, grs. x. to grs. xv. of the acid, every hour or two hours, mixed with an equal quantity of borax to insure solubility, and administered with mucilage or glycerin, either in bolus or solution. Salicin is prescribed in similar doses. Sodium salicylate is used in somewhat larger doses.

For **surgical purposes** a convenient **solution** of medium strength is made with 1 part each of salicylic acid and borax, with 30 to 50 parts of water. An **ointment** is prepared with 1 part acid, mixed in a heated mortar, with 20 to 25 of vaselin or bland oil. The B P. ointment consists of 1 part acid, 18 soft paraffin, and 9 hard paraffin. Lint, cotton-wool, or jute, soaked in a strong, hot, watery solution, made with borax to insure solubility, absorbs the acid, and is used as an antiseptic covering for wounds and burns in the same manner as carbolic, boric, or sanitas lint. Being unirritating, salicylic lint is applied directly to abraded surfaces without the intervention of any protective. **Iron salicylate** is antiseptic and astringent.

A **salicylate of phenol** has recently been used under the title of "Salol" as an antiseptic and antipyretic in rheumatism, and is credited with special power of destroying cholera germs.

"SANITAS."

"SANITAS" occurs in the form of oily and watery fluids, prepared by oxidation of oil of turpentine, and containing or generating camphorous bodies and hydrogen peroxide.

A current of air is driven by an engine, for about 120 hours, through a series of Doulton's stoneware receivers, surrounded by vats of water maintained by steam at a temperature of 140° F. In each receiver are placed 30 gallons of American, Russian, or Swedish oil of turpentine, and about

double that amount of water. The oil gradually becomes darker in colour; its specific gravity and boiling point are raised; and it acquires a balsamic odour resembling camphor and peppermint. As the process continues, **the turpentine** ($C_{10}H_{16}$) **is oxidised,** producing camphoric peroxide ($C_{10}H_{16}O_3$), which Mr C. T. Kingzett, F.I.C., F.C.S., has demonstrated to be gradually converted into another antiseptic camphoric substance ($C_{10}H_{16}O_2$), and the soluble hydrogen peroxide which passes into solution in the water.

Mr Kingzett has further shewn that all the several **essential oils of the terpene series** ($C_{10}H_{16}$), as well as cymene ($C_{10}H_{14}$) and menthene ($C_{10}H_{18}$), **undergo similar oxidation,** and give rise to the same products. In this way pine forests, especially during sunshine following rain, render the atmosphere not only pleasantly balsamic, but antiseptic, more highly oxygenated, and curative for throat and lung complaints. The Eucalyptus globulus in like manner pours forth these antiseptic and highly oxygenated volatile products, which are antidotes for malaria, and sometimes, it is said, even arrest the progress of pulmonary consumption; while, on a smaller scale, every plant or flower producing an essential oil exerts similar oxygenating and purifying effects.—(*Nature's Hygiene*, by C. T. Kingzett, F.I.C., F.C.S. Ballière & Co.)

When the manufacture of "Sanitas" is completed, there floats on the surface of the aqueous solution a yellow-brown dense **oxidised oil** of turpentine, consisting chiefly of camphoric peroxide. This "Sanitas" oil, mixed with a suitable mineral or other basis, constitutes a useful disinfecting and deodorant powder. It is introduced into various soaps, conferring disinfectant properties, and mixed with vaselin, oils, or fats, forms serviceable antiseptic liniments and ointments. Melted with Dammar resin and paraffin wax, a mixture is obtained which is used to impregnate muslin, forming an antiseptic gauze. Disinfectant desiccants are prepared by admixture with chalk or starch.

The watery solution, cleared by filtration, and known as **"Sanitas fluid,"** consists chiefly of thymol, a proportion of the camphorous constituents which characterise the oil, and hydrogen peroxide. This hydrogen peroxide is itself a power-

ful oxidising agent; it parts with oxygen much in the same way as ozone, and gives off 475 times its volume of oxygen (*Pelouze*). It effectually prevents fermentation, destroys bacteria, and has been successfully used in human surgery for dressing ulcers and diphtheritic sore throat.

Mr Kingzett has lately introduced a series of **bactericides,** in which 5 per cent. of such active antiseptics as mercuric and zinc chlorides, boric, sulphophenic and carbolic acids, chloral, and chloroform, are each united with five volumes of hydrogen peroxide. The mercuric bactericide has been specially serviceable in antiseptic surgery. Mr Kingzett claims that effectual antiseptics and disinfectants are thus produced, which yield, when required, five times their volume of nascent oxygen, and have the power of destroying not only micro-organisms, but the toxic products to which they give rise.

ACTIONS AND USES.—"Sanitas" oil and fluids are volatile non-poisonous antiseptics, disinfectants, and deodorants. Their several constituents in various ways attack and destroy enzymes, organised ferments, and the lower forms of vegetable and animal life. The "Sanitas" preparations have an agreeable aromatic odour, are not corrosive, and do not stain or otherwise injure clothing or other textile fabrics. Their power of checking fermentation has led to the administration of the fluid to calves fed on milk, and suffering from dyspepsia or diarrhœa; an ounce is prescribed with six ounces of water, and may be conjoined with spirit, ether, or chloroform.

Useful **antiseptic lotions** for wounds, ulcers, and bruises are prepared with 1 part of the fluid, diluted, according to circumstances, with 4 to 10 parts of water. Ointments and liniments are prepared with about the same proportions of oils and fats. When wounds, for ten days or longer, have been treated with carbolic or other irritant dressings, granulation and skin growth often proceed more satisfactorily with the substitution of the milder "Sanitas." In sore throat, diseases of the sinuses of the head, aphtha, and foot-and-mouth complaint, solutions or sprays are often useful; and, being devoid of irritant effects, are also serviceable for rectal, uterine, and vesical injections. "Sanitas" solutions and soaps not only cleanse and disinfect, but gently stimulate the skin, abate

itching, remove scurf, and promote healing in prurigo, chronic eczema, or other skin complaints. "Sanitas" fluid, diluted with 20 to 50 parts of tepid water, is serviceable for sponging febrile patients, and for **disinfecting** animals affected with contagious disease. "Sanitas" oil **destroys** the **parasites** of scab and mange, as well as lice, fleas, and maggots, and arrests the cryptogamic growth of ringworm. Even in concentrated form, there is no risk of its exciting undue irritation, or inducing from its absorption injurious constitutional results, such as are apt to follow the free use of strong carbolic preparations.

Mr A. J. Sewell, Elizabeth Street, Eaton Square, London, has employed "Sanitas" successfully in **canine practice.** The fluid, diluted with 4 to 6 parts of water, he has used in canker of the ear, in ulceration of the mouth, and in eczema, and as a uterine injection after parturition. The oil he finds useful "as a dressing for mange, and for disinfecting the kennels and rooms occupied by dogs suffering from distemper and mange."

"Sanitas" powder and "Sanitas" sawdust are used with good effect for **disinfecting** and **deodorising** stables, kennels, cow-houses, and piggeries. Sprinkled upon the floors, they also purify the air of slaughter-houses, menageries, manufactories where fermentible materials are employed; while on ship-board they destroy unpleasant odours, and substitute their own camphoric aroma. These "Sanitas" preparations are largely used in hospitals, and by medical officers of health.

SAVIN.

SABINÆ CACUMINA. Fresh and dried tops of Juniperus Sabina; collected in spring from plants cultivated in Britain. (B. P.) *Nat. Ord.*—Coniferæ.

Juniperus Sabina is an evergreen shrub, common throughout Middle and Southern Europe, and cultivated in this country. The tops or young branches, with their attached leaves, when fresh are green, but become yellow when kept; have a strong, heavy disagreeable odour, and a bitter, acrid, resinous taste.

They communicate their properties to water, spirit, and the fixed oils, and owe their activity to about three per cent. of a colourless or pale yellow **volatile oil,** prepared from the fresh tops by distillation, isomeric with oil of turpentine ($C_{10}H_{16}$), and associated, as constantly occurs in plants, with a more oxidised oil ($C_{10}H_{16}O$). From the berries 10 per eent. of these oils is said to be obtained *(Phillips).* The tops of another conifer, the **Thuja** occidentalis or arbor vitæ, are occasionally used in America, owe their properties to similar volatile oils, and closely resemble Savin.

The brown empyreumatic **oil of cade,** imported from the Continent, and in much repute as an insecticide, is obtained from the dry distillation of the brown-berried juniper—the Juniperus Oxycedrus—a native of countries bordering the Mediterranean, and from other Coniferæ.

Actions and Uses.—Savin applied externally is rubefacient and vesicant. Administered internally, moderate doses are stimulant, anthelmintic, and diuretic; they stimulate especially the urino-genital organs, are allied to the turpentines, and in large doses produce gastro-enteritis. Excretion occurs by the skin, pulmonary membrane, and kidneys.

Toxic Effects.—Hertwig has given **horses** half a pound twice daily for six or eight days, without effect; Professor Sick administered small doses for half a year, without notable symptoms; but these observations probably underrate its activity. Mr Rose records the poisoning of five horses, of which one died immediately, and two after five days; the others recovered, after suffering from diarrhœa, intense thirst, quickened pulse and breathing, with great prostration (*Veterinary Record* for 1850). Two drachms kill **rabbits** in a few hours, producing extreme congestion of the intestines, kidneys, and bladder. Orfila records that four drachms destroyed **dogs** in thirteen hours, when the gullet was tied to prevent vomiting; and similar effects follow when powdered savin is applied to a wound or introduced underneath the skin. Vomiting, purging, gastro-intestinal inflammation, and collapse were produced. The kidneys and bladder were likewise irritated, usually causing copious discharge of bloody urine.

The **uterus** is also **irritated,** and savin has been ignorantly

used to produce abortion and hasten parturition. Two cases of abortion in mares heavy in foal are recorded by Mr Millet of Henley-on-Thames, in the *Veterinarian* for 1855. In these cases, the continued use of savin destroyed both foals, and, being still persevered with, caused their expulsion apparently ten or twelve days later.

MEDICINAL USES.—Savin cannot be safely used to produce abortion or hasten parturition. It stimulates the uterus, and expels its contents only as a result of dangerous irritation of the intestines and urinary organs. Unlike ergot it does not directly contract the muscular fibres of the uterus. It is occasionally used chopped with fodder for the destruction of intestinal worms, but is neither so safe nor so certain as oil of turpentine, or other remedies. If used at all, the best form is the essential oil. Decoctions of the tops in an alkaline ley and the essential oil are occasionally applied as antiseptics and stimulants to indolent wounds and warts.

DOSES, ETC.—As an anthelmintic—the only purpose for which savin is administered—f ʒ iij. to f ʒ iv. of the volatile oil is given to horses or cattle; ♏ iij. to ♏ v. to dogs, dissolved in any mild fixed oil or in mucilage. For external application, decoctions and ointments are used. Equal parts of savin and verdigris ointments is a popular stimulant dressing for foot-rot in sheep.

SILVER AND ITS MEDICINAL COMPOUNDS.

SILVER NITRATE. Argenti Nitras. Lunar Caustic. Lapis Infernalis. ($Ag\ NO_3$.)

When metallic silver is heated with diluted nitric acid, nitric oxide gas is evolved, and as the solution is evaporated, silver nitrate crystallises in colourless right rhombic prisms. To form the familiar sticks or pencils, the salt is fused and run into moulds. Toughened caustic is prepared by adding, before fusion, 1 part potassium nitrate to 19 parts silver nitrate.

Argenti nitras is devoid of odour, has a disagreeable, caustic, metallic taste, remains permanent in the air, but blackens on exposure to light or in contact with organic matters. It is

soluble in its own weight of temperate water, and in four parts of boiling rectified spirit. It blackens the cuticle, and corrodes soft animal tissues.

Like other silver salts, it is **distinguished** by giving, with hydrochloric acid, a curdy-white precipitate of silver chloride ($Ag\,Cl$), insoluble in nitric acid, but soluble in ammonia, and darkened by exposure to light. Hydrogen sulphide yields a black precipitate of sulphide ($Ag_2\,S$). Caustic potash solution throws down the brown hydrate ($Ag\,OH$), which readily loses water, being converted into the oxide ($Ag_2\,O$). Potassium iodide produces a pale yellow precipitate of iodide ($Ag\,I$); potassium chromate a red precipitate of chromate ($Ag_2\,Cr\,O_4$).

Actions and Uses.—It is astringent, irritant, and corrosive, is much used as a caustic, and is prescribed as an astringent and nerve tonic. It induces emesis in animals capable of vomiting. Large doses cause gastro-enteritis, and chronic poisoning is accompanied by fatty degeneration. The nitrate is the only silver salt generally used; but the Pharmacopœias also recognise the oxide and iodide.

Toxic Effects.—Like iron zinc and copper salts, which it resembles, silver nitrate readily **unites with albumin**. The solid nitrate or strong solutions, **irritate and cauterise** animal tissues, with which they are brought into contact. 30 to 60 grains given to dogs, when vomiting was prevented, caused fatal **gastro-enteritis,** sometimes accompanied with convulsions. When administered for some time it blackens the skin, and has also been detected in the liver and spleen. As in the case of arsenic and antimony, chronic poisoning is characterised by **fatty degeneration.** Unduly irritant effects, produced whether internally or externally, are diminished by solution of common salt, which forms the insoluble and inert chloride.

Rosenstern, experimenting on the vessels of the mesentery of frogs with weak solutions of various astringents found silver nitrate most powerful; lead acetate followed next in order, requiring for production of a given effect a solution five times as strong; ferric-chloride acted only feebly; alum caused dilatation (*The Practitioner*, September 1876). It is slowly excreted in the albuminous secretions and in the bile.

MEDICINAL USES.—As a **tonic,** it is prescribed in chorea and epilepsy, especially amongst dogs. Like arsenic, it is sometimes used to check chronic gastric irritation. Alone, or in combination with opium, it is given as an **astringent** in chronic diarrhœa, dysentery, and cholera in dogs; while enemata of 5 to 10 grains to the ounce of distilled water, or of starch gruel, are occasionally also used.

Applied to irritable, relaxed, abraded skin or mucous surfaces, it coagulates mucus and albumin, **constringes dilated vessels,** produces a white film of chloride, which quickly deepens in colour, from the reduction of the salt to the conditions of sulphide and metal. The solid nitrate or strong solution, rubbed into the skin, **raises blisters.** The eschar remaining, after a free dressing, gradually cracks and peels off, leaving usually a healthy surface beneath. The solid nitrate acting superficially, and readily localised, is for many purposes preferable to fluid caustics, or to the deliquescent caustic potash. It is serviceable for **destroying parasitic fungi,** such as tinea, removing warts and other hypertrophies of the skin, and checking the progress of such boils as those of farcy. A crystal rolled in a piece of tissue-paper is sometimes substituted for corrosive sublimate in **fistulæ** not easily got at with the knife, and a few days after its introduction causes sloughing of the hard walls of the canal, and leaves a healthy granulating surface. Mr Robert Littler, of Long Clawson, regards it as one of the most effectual remedies for the interdigital inflammation and discharge which constitute one of the familiar forms of **foot-rot in sheep.**

A light dressing of the solid caustic, or a weak solution, promotes a healthier condition of **indolent wounds** and ulcers, represses over-luxuriant granulations, often arrests the irritability of circumscribed attacks of **erythema,** eczema, or pruritus, and is an excellent dressing for obstinately **sore teats** in cows. When painted around an erysipelatous spot, it sometimes limits its spreading. Solutions of 10 to 20 grains to the ounce of water destroy the parasites of mange and scab.

A solution, containing 2 to 5 grains to an ounce of water, abates the pain and congestion of **conjunctivitis,** and stimulates and heals the inflamed suppurating eyelids of weakly

dogs. It removes specks and opacity of the cornea, if of recent origin and produced by accidents, but is of little avail in cloudiness of the cornea, resulting in horses from repeated attacks of periodic ophthalmia. Solutions of 10 to 30 grains to the ounce of water, conveniently applied with a spray-producer, are sometimes used to control **laryngeal ulceration,** follicular tonsillites, and pharyngitis.

Doses, etc.—Horses and cattle, grs. ij. to grs. v. ; sheep, grs. j. to grs. ij. ; pigs, gr. ss. to gr. j. ; dogs, gr. $\frac{1}{8}$ to gr. ss. It may be repeated two or three times daily, and, on account of its disagreeable taste, is given in bolus. When its astringent effects are to be directed upon an ulcerated or discharging portion of intestine, the bolus should be made with kaolin, and given coated with keratin (p. 434). For external purposes, the **sticks** are sometimes coated with wax to preserve them from the decomposing action of air and light, and are held in quills or forceps to prevent their blackening the fingers. An **ointment** is occasionally made with grs. v. to grs. viij. to the ounce of vaselin or lard. Solutions require to be protected from light, and kept in bottles with glass stoppers.

SOAPS.

Sodium or Hard Soaps. Sapo durus. Sodium stearate and oleate.

Potassium or Soft Soaps. Sapo mollis. Potassium oleate.

Soap consists of **a fatty acid in combination with an alkaline base.** The hard soaps are made with carbonated or caustic soda, boiled with tallow, palm, or cocoa-nut oils. The soft soaps are made with carbonated or caustic potash, boiled with seal or whale oils. In their manufacture, the fatty materials are first boiled with a weak alkaline ley, and stronger leys are gradually added. The alkali unites with the fatty acid, displacing the basic glyceryl (p. 398). The following equation represents the decomposition which occurs with the solid stearin, which forms 3 parts of tallow. The fluid olein ($C_3 H_5 . (C_{18} H_{33} O)_3 . O_3$), which constitutes $\frac{1}{4}$th part of tallow, and is the chief constituent of olive oil, and the solid palmitin ($C_3 H_5 . (C_{16} H_{31} O)_3 . O_3$), which makes up

the bulk of palm oil, undergo similar changes when boiled with an alkali:—

Stearin.		Caustic Soda.		Sodium Stearate.		Glycerin.
$C_3 H_5 . (C_{18} H_{35} O)_3 O_3$	+	$3Na HO$	=	$3Na (C_{18} H_{35} O)O$	+	$C_3 H_8 O_3$.

Hard soap thus chemically consists of sodium stearate, oleate, or palmitate, or a mixture of these. It is separated from the gelatinous boiling ley by addition of common salt, which causes it to form into flakes, which are collected, run into moulds, and dried. It consists of a mixture of sodium stearate, with about one-third of oleate, and from 30 to 60 per cent. of water. To make yellow soap, the ley, while being concentrated, is treated with considerable quantities of resin. Many soaps are now made with a large percentage of silicates. **Mottled and marbled soaps** owe their colour to the presence of a little iron. **Glycerin soap,** prepared by heating the soap ley with water for two or three hours at 400° F., contains a mixture of soap and glycerin. Castile and other Pharmacopœia soaps are directed to be made with olive oil, which is, however, too expensive for ordinary soap-making. **Soft or potash soaps** are not treated with common salt, but are gradually evaporated to the required consistence. Their disagreeable smell results from the rancidity of the oils used in making them.

Soaps have an alkaline acrid taste, dissolve readily in water and spirit, but should not impart an oily stain to paper. When heated they fuse, swell up, and leave charcoal and carbonate of their alkalies. Calcium and magnesium salts, such as occur in hard waters, decompose soap; the fatty acids form insoluble flakes of stearate and oleate of calcium and magnesium; while the solubility of the alkali is also diminished by its conversion into carbonate or sulphate. Soap is hence used as a **test for the hardness of water.**

Actions and Uses.—Soaps are mildly laxative, diuretic, emetic, and antacid. They form convenient adjuncts to more active laxatives or diuretics, and are serviceable additions to laxative clysters. Externally, they are used as stimulants, detergents, and lubricants; and in pharmacy as excipients.

Soap and warm water are in every-day use for **cleansing the skin,** removing scurf, neutralising acrid fatty matters,

keeping open the orifices of sebaceous glands, and preparing the skin for the action of blisters, or for absorbing various drugs. When, from badly fitting harness or other causes, **erythema** or **intertrigo** is produced, irritation is abated by rubbing the parts with soap, and subsequently dressing with vaselin, with vaselin and sugar of lead lotion, or with "Sanitas" or other soothing antiseptic powder. Gently rubbed over slight **burns** or **scalds,** soap prevents access of air and relieves irritation. A thorough washing, night and morning, **removes** the **scales** of psoriasis, and with smart friction lays bare the burrows of the mange or scab acari, for the effectual action of special parasiticides. In chronic **eczema,** soft soap, from its lubricant and alkaline properties, is often useful. For such cases a convenient dressing is made with equal parts soft soap and glycerin, half a part of zinc oxide, and 6 or 8 parts water. For eczema and other itching skin diseases, Dr M'Call Anderson prescribes equal parts of soft soap, oil of cade, and rectified spirit. As a **stimulant** for bruises and strains, for warming horses' chilled legs, or for producing counter-irritation in sore throat, six ounces of hard soap, cut into small pieces, are macerated with six fluid ounces of dilute liquor ammoniæ, and one pint each of proof spirit and linseed oil; two or three ounces of camphor are sometimes added. Soap and water is much used for laxative clysters. A cone of hard soap inserted into the anus helps to evoke tardy action of the bowels in young animals. As **internal antacids,** soaps are less effectual than alkaline carbonates or bicarbonates, but are occasionally administered in poisoning by acids and metallic salts. Soap and water causes **emesis in dogs** as well as men. Soaps are used as excipients for boluses, and as constituents of liniments and plasters.

SODIUM AND ITS MEDICINAL COMPOUNDS.

Sodium salts abound in the ashes of marine and maritime plants. They occur native in the Chili nitre beds and in borax; but their chief commercial **source** is the chloride obtained from rock-salt deposits, or from the evaporation of sea-water. They are soluble, with the single exception of the antimoniate,

which goes down very slowly from solution. They are **distinguished** by their negative reaction with the several group tests, and by their communicating to the flame of burning alcohol a bright yellow colour.

ACTIONS AND USES.—Sodium salts, chiefly as albuminates, chlorides, and phosphates, are **constituents** of the blood, bile, serous fluids, and indeed **of all animal secretions and textures.** Dr Lauder Brunton thus describes their general action:—"They diffuse more slowly than those of potassium. They are neither absorbed nor excreted so readily, and have not a marked diuretic action. When locally applied to muscle and nerve in large doses, they paralyse both, but not so powerfully as salts of potassium, nor have they such a paralysing action upon the involuntary muscle either of the heart or the intestine" (*Pharmacology, Therapeutics and Materia Medica*). The more soluble salts in small doses and diluted solution are chiefly **excreted by the kidneys**; while the less soluble in larger doses and more concentrated solution are **removed by the bowels.**

Like potassium salts, they **may be grouped** as follows:—

1. The hydrate carbonates and salts of organic acids, which in the body are converted into carbonates, are antacid, alterative, and slightly diuretic. The hydrate and carbonate are caustics. Sodium ethylate B. P. solution contains 19 per cent. of the solid salt (NaC_2H_5O), is a colourless syrupy liquid, becoming brown by keeping, and is used as a caustic.

2. The chloride, sulphate, nitrate, and permanganate are antiseptics, febrifuges and refrigerants; small doses are slightly diuretic, while large doses are cathartic.

3. The borate, benzoate, hyposulphite, sulpho-carbolate, chlorate, salicylicate and valeriante resemble their acid or salt radical rather than their base.

SODIUM CARBONATE. Sodæ Carbonas. Carbonate of Soda. $Na_2\,CO_3.\ 10Aq.$

SODIUM BICARBONATE. Sodæ Bicarbonas. Bicarbonate of Soda. Hydro-sodium Carbonate. $NaHCO_3$.

Sodium hydrate or **caustic soda** (NaHO) and solution of

soda resemble in their preparations and general properties the corresponding potassium compounds, but are little used in veterinary practice.

The **carbonate** was formerly prepared by lixiviating the ashes of marine or maritime plants, and from the native sesquicarbonate or natron found as an efflorescence on the margins of lakes in warm climates. For the manufacture of soap and glass, for washing, and other purposes, the 200,000 tons now annually required in this country are chiefly **obtained from common salt** by heating it in furnaces with sulphuric acid; the sulphate thus prepared is converted into sulphide, and thence into carbonate, by roasting with coal or slack and limestone; lixiviating, calcining, and crystallising. From a saturated solution of this soda ash there separate large transparent colourless, laminar, rhombic crystals of hydrated carbonate (Na_2CO_3. 10Aq). The water may be driven off by heating to 120° F., when the dried granular B. P. sodium carbonate remains. The carbonate in its several forms is alkaline to taste and re-agents, efflorescent, and soluble in 1 to 2 parts of water.

The **bicarbonate** is produced by saturating the carbonate with carbonic acid gas; or by passing carbonic acid gas through a strong solution of common salt mixed with ammonia. It occurs as a white crystalline powder, or aggregation of irregular opaque scales, has a saline, slightly alkaline, not unpleasant taste, is soluble in about 10 parts of cold water, and is distinguished from the carbonate by its feeble alkalinity, and its giving a colourless instead of a coloured precipitate with corrosive sublimate. **Soda water**, as ordinarily sold, is simply aerated water; but the officinal article contains in every pint 30 grains of bicarbonate, and is saturated with carbonic acid gas, dissolved under pressure of four atmospheres.

Actions and Uses.—Sodium carbonate and bicarbonate are antacids and alteratives. They differ only in the degree of their action, and resemble the corresponding potassium salts.

Medicinal Uses.—Small doses given a quarter to half-an-hour before meals **increase secretion of gastric juice.** Given with or after food they aid the emulsionising and digestion of fats and neutralise the acid of the gastric juice,

as well as any acid produced by excessive fermentation of food. They are hence sometimes servicable in relieving **indigestion and flatulence,** their efficacy being increased by administration with aromatics or stimulants. Young calves fed on stale skim milk, and suffering from atonic dyspepsia are often relieved by 1 to 2 drachms of bicarbonate dissolved in each meal of milk. They are **antidotes** for poisoning by mineral and other acids. Being less irritant than the corresponding potassium salts, they are preferred for stimulating secretion of gastric juice and neutralising acids in the alimentary canal, while potassium carbonates are more effectual antacids in rheumatism or acid condition of the urine, and are more active diuretics.

Sodium carbonate solutions **lessen** the **irritation** of urticaria lichen and other skin eruptions, but are not so effectual as potassium carbonates or cyanide. In more chronic cases the alkaline dressings are alternated with tar or oil of cade. The simple white non-puriform leucorrhœa is usually arrested by two or three injections of sodium bicarbonate. A strong solution greatly checks the pain of burns.

Doses, etc.—Of the carbonate horses and cattle take ʒj. to ʒij.; sheep and pigs, grs. x. to grs. l.; dogs, grs. v. to grs. xv. The bicarbonate, although about half the activity of the carbonate, is more convenient for general use, and is given in double these doses, either in bolus or solution. It is frequently given to dyspeptic, diabetic, or febrile horses, dissolved in their drinking water.

Sodium Borate. Sodæ Biborate. Borax.

$Na_2 B_4 O_7 . 10Aq.$

Borax occurs native in certain Austrian mineral waters, as an incrustation on the edges of various lakes in Thibet and Persia, and in streams in Southern California. As crude borax or tincal, it is imported from Calcutta in greenish pieces, moistened with oil to prevent efflorescence. It is purified by calcining and recrystallising. Most of the borax used is now got by calcining together, in proper proportions, boric acid and sodium carbonate.

Its colourless, oblique six-sided prisms effloresce, and become opaque, have a saline cooling taste, are soluble in 12 parts of cold and 2 of hot water, and are still more soluble in glycerin, which is hence a capital vehicle for applying it. Heated, it melts in its water of crystallisation, and swells into the porous **borax usta ;** at a red heat it becomes the transparant glass or anhydrous borax used as a flux. A hot saturated solution, treated with a mineral acid, deposits the crystalline scales of boric acid.

ACTIONS AND USES.—Borax is antiseptic, and is used to relieve irritation of the skin and mucous membranes.

It has notable **antiseptic** powers ; 1 part in 100 of water arrests the action of emulsin, diastase, and ptyalin ; while 1 part in 1000 of water prevents the action of rennet ; it requires, however, according to Koch, 1 part in 48 of water to kill developed bacteria.

It has been occasionally prescribed in the same doses as the bicarbonate in cases of **gastric irritation.** It is chiefly useful as an antiseptic in **aphthous conditions** of the mouth and throat, is sometimes conjoined with potassium chlorate, and applied either in powder or with glycerin or " Sanitas." It **allays irritation and itching** in many cases of erythema, intertrigo, eczema, and psoriasis. It is preferable to more active and poisonous remedies for dogs which are apt to lick their dressings. In acute eczema, 1 part of borax and 1 of alumen acetate are sometimes serviceable, dissolved in 50 parts of water. It is an effectual injection for leucorrhœa. In America it is used for the destruction of cockroaches. It is a good solvent for benzoic acid.

SODIUM SULPHATE. Sodæ Sulphas. Sulphate of Soda. Glauber's Salt. $Na_2\,SO_4.\,10Aq.$

The sulphate effloresces on the surface of the soil in various parts of India, occurs in masses in Spain, and is a constituent of sea-water, of many aperient mineral waters, of various plants, and of several animal secretions. When 2 parts sodium chloride are heated with 1 part sulphuric acid, hydrochloric acid is evolved, and sodium sulphate crystallises from the solution. It occurs in colourless transparent oblique

prisms, which effloresce on exposure to air, have a saline, bitter taste, and at 60° F. are soluble in less than their own weight of water.

ACTIONS AND USES.—It is cathartic, slightly diuretic, febrifuge, and cholagogue.

Unlike the magnesium sulphate, it has no toxic effect when injected into the circulation. Like other saline purgatives, it has a low diffusive power; it impedes absorption of fluids present in the intestines, increases both **secretion** and **peristalsis,** and thus augments the quantity and fluidity of the dejections. Not only does it carry away bile lodged in the duodenum, and thus prevent its reabsorption, but Professor Rutherford, experimenting on fasting dogs, found that, unlike the magnesium sulphate, it acts upon the hepatic cells and **augments secretion of bile.** The **phosphate** has a similar moderate cholagogue action, and both are accordingly with reason used in congested conditions of the liver. As with other salines, although large doses are removed by the bowels, small doses freely diluted pass off, in great part unchanged, by the kidneys. Although seldom used for horses, it is still occasionally prescribed for cattle and sheep, for the same purposes as Epsom salt, with which it is sometimes conjoined. In dogs it acts both as an emetic and purgative.

DOSES, ETC.—As a purgative, cattle take lb. j. to lb. jss.; sheep, ℥ij. to ℥iv.; given with ginger and treacle, and succeeded by liberal supplies of chilled water.

SODIUM SULPHITE. Neutral or Normal Sulphite. Sodii sulphis. $Na_2\,SO_3.\ 7Aq.$

SODIUM THIOSULPHITE. Hyposulphite of Soda. Sodii hyposulphis. $Na_2\,S_2\,O_3.\ 5Aq.$

When sulphurous acid gas is passed through a concentrated solution of sodium carbonate, four-sided crystals are deposited of the **acid sulphite** ($Na\,H\,SO_3$), which is acid in taste and reaction, and has an odour of sulphurous acid. When this acid salt is saturated with sodium carbonate, there is produced the **normal sulphite,** which is soluble alkaline, and much used as a reducing agent, and for bleaching.

Sodium hyposulphite is prepared in the laboratory by dissolving sulphur in a boiling solution of sodium sulphite and crystallising; but on the large scale is got from the tank waste of the alkali works, which contains calcium sulphide, by exposing it to the air and treating with sodium sulphite. The hyposulphite is very soluble in water, and fusible. It is more permanent than the sulphite. It is used in photography for fixing prints, and as an antichlore in bleaching and paper-making.

Actions and Uses.—The sodium sulphites and hyposulphites are antiseptics, deodorisers, and insecticides. In the presence of acids, without and also within the body, they give off sulphurous acid, which they therefore resemble. They **destroy ferments** and **bacteria,** and remove offensive smells—properties greatly increased when they are used along with the tar acids. When standing long in contact with water, the sulphite has the disadvantage of decomposing, and gives off hydrogen sulphide.

General Actions.—The sulphites and hyposulphites, when swallowed, are absorbed, remove noisome smell and acridity from unhealthy secretions, and are excreted mostly as sulphates. Professor Polli, of Milan, made upwards of three hundred experiments with acid sulphite, mostly upon dogs, and found that it neutralised, or at any rate **materially diminished, the effects of animal poisons.** He gave dogs 225 grains daily with impunity for a fortnight; very moderate doses were detectable in twenty-four hours in the blood, liver, and urine; two ounces of blood drawn from dogs, which for five days had received daily with their food 30 grains of sulphite, kept fresh for three weeks; while blood taken from dogs similarly fed, but receiving no sulphite, became putrid within a few days. Full doses, given previous to death, retarded or prevented putrefaction of the body. Into the thighs of two dogs Professor Polli injected 15 grains of fœtid pus from an unhealthy abscess, and next day repeated this injection. Both dogs were stupefied, reeled, and tottered when made to walk, while their pulse and breathing were much quickened. For five days previously both dogs had been treated exactly alike, with this difference only, that one had

received daily 30 grains of sodium sulphite, which was continued throughout the experiment. In four days after the injection this dog was again eating, and the wound in his thigh healing. The other, getting no sulphite, daily became worse, the limb got gangrenous, and in ten days he died exhausted. Similar results followed injection into the femoral vein of bullock's blood kept for four months, and offensively putrid. Dogs that had previously received the sulphite recovered their appetite and were almost well in three days; while those managed in the same manner, but not receiving sulphite, died comatose in five days, suffering from low fever, and with the limb gangrenous. Another experiment, still more striking, was made with the muco-purulent discharge from a glandered horse. Forty-five grains were injected into the femoral veins of two strong, healthy dogs, one of which for several days had received two drachms daily of sodium sulphite. Both were drowsy and panted, but the animal protected by previous administration of the sulphite, although at first seeming to suffer most, was in a few hours able to eat, and was next day in tolerable health. The other, however, became more drowsy, and stood with difficulty; by the third day, the limb was tender and œdematous; by the fourth, gangrene set in, and a purulent discharge ran from the nose and eyes; while, on the sixth day, the beast died, worn out by pain, diarrhœa, and fœtid suppuration.

Medicinal Uses.—These experiments held out great hopes that septic disorders might be prevented or cured by sulphites. But repeated careful clinical observation has not justified the high expectations formed of them, and their administration does not appear to arrest or materially alter the course of febrile, contagious, or zymotic diseases. Amongst horses they have been given in **febrile attacks,** and in such cases many American practitioners have given me favourable reports of them. Reasoning from their physiological actions, they should be serviceable in inveterate skin disorders, tedious cases of strangles, rheumatism, and farcy. They **relieve acidity** and **flatulence** occurring in badly-fed young calves. Ounce doses of acid sulphite, given thrice daily, I have found lower temperature, and relieves the breathing in contagious pleuro-

pneumonia in cattle. In cattle plague it has been given both by the mouth and injected into the veins, and although it did not cure, it abated fever, lowered excessive temperature, and prolonged life (*Report on Cattle Plague*). Mixed with treacle and placed within the lips, it diminishes irritation, smell, and acrid discharge in **foot-and-mouth disease.** Used alone, and occasionally with potassium chlorate, it has been given to young cattle to prevent attacks of black leg; half-ounce or ounce doses, for this object, being administered with the ordinary food for three or four days consecutively during every fortnight. It is difficult to estimate the precise value of such preventives, adopted, as they often are, in conjunction with more careful feeding and management. Ten to twenty grains of sulphite, or one-fourth the dose of hyposulphite, given twice daily, help to keep the bowels regular, diminish offensiveness of the secretions, and abate the low fever occurring in **distemper in dogs.**

Doses, etc.—Of the sulphites, horses and cattle take ℥ss. to ℥j., sheep and pigs, ʒss. to ʒj.; dogs, grs. x. to grs. xxv. Of the hyposulphite, about one-fourth these doses suffice. Either drug is prescribed in powder or solution, and may be repeated several times daily. Having little taste, they may usually be taken mixed with the food. They may be conjoined with ginger, gentian, camphor, or ammonium carbonate.

Sodium Chloride. Chloride of Sodium. Muriate of Soda. Common Salt. Na. Cl.

Salt is found in extensive rock deposits in Poland, Spain, and other parts of Europe, and in this country in Cheshire and Worcestershire. It exists in variable amount in every soil, and hence in every water, is the largest saline constituent of the ocean, and abounds in the tissues and fluids of plants and animals. It is obtained for medicinal and economical purposes by quarrying the solid beds of rock salt, or by evaporating brine springs or sea-water.

It forms cubical crystals, which vary in size according to the rapidity of their formation. When pure, it occurs in

small, white, crystalline grains, or transparent cubic crystals free from moisture, and has a purely saline taste (B. P.) From the presence of magnesium and calcium chlorides, many samples are deliquescent. It is soluble in about $2\frac{3}{4}$ parts of water, at all temperatures. It is rather more than twice as heavy as water.

Actions and Uses.—Salt is an essential article of food; small doses are restorative, stomachic, and antiseptic; larger doses are irritant, cathartic, and emetic; it is used externally as a stimulant, antiseptic, and refrigerant.

General Actions.—So essential is the regular or frequent **use of salt for the maintenance of health,** that animals in a state of nature instinctively travel many miles to saline springs, the sea-shore, or incrustations or beds of salt. M. Boussingault, experimenting on the dietetic value of common salt (*Annales de Chimie et de Physique*, 1847, tom. xix.), selected six cattle, as equal as possible in weight and appearance, and fed them in exactly the same manner, except that three received each 1·2 ounce of salt daily, whilst the other three got none. In about six months, the skin and hair of those without salt became rough, dry, and staring, presenting a striking contrast to the smooth, shining coats of the others, which, although little heavier than their neighbours, were more lively, and of so much better appearance that they brought a somewhat higher price. The cattle receiving salt exhibited throughout greater appetite and relish for their food, consumed it in a shorter time, and also drank larger quantities of water.

Salt is especially necessary for animals receiving cooked grains, or roots, in the preparation of which part of the salt is apt to be dissolved out. Animals should have **access to salt at all times;** a piece of rock salt should constantly lie in the horse's manger, the ox's crib, and the sheep's trough. The condiment not only gratifies the palate, but also, as indicated, serves important nutritive purposes. It furnishes hydrochloric acid for the gastric juice, and soda salts for the bile; it assists in the diffusion of fluids through membranes, and in maintaining the solution of the globulins. Around an inflamed spot, notably in pneumonia, common salt accumulates, and its subsequent increase in the urine often marks the subsidence of

the attack (*Bartholow*). During convalescence from acute disease the chloride and other sodium salts are removed from the body in unusual amount, and most animals then instinctively take salt freely. Besides itself furnishing an essential constituent of the animal fluids and solids, it appears to **assist** in the **assimilation** of nutritive matters. On the absorption of calcium salts it has a marked effect, for when withheld from dogs with fractured limbs, repair and union are tardy.

It is **excreted** by the mucous membranes and kidneys.

In common with other cathartic salines, it exerts an **excito-secretory action on the glands of the intestines**; it besides impedes absorption of fluid from the bowels, which thus become mechanically distended with fluid. Their contents are softened and peristalsis is encouraged. The blood not only does not obtain from the bowels its usual supply of fluid, but pours serous secretion into the bowels. Within an hour or two after administration of a saline cathartic the blood becomes concentrated, and thereafter gradually recoups itself from the tissues, thus promoting absorption of fluid and waste materials. Professor Rutherford's experiments on fasting dogs indicate that common salt **slightly increases secretion of bile,** in this respect resembling sodium sulphate rather than magnesium sulphate.

On **horses** the cathartic action of common salt is uncertain, often violent, and usually accompanied by considerable irritation of the kidneys. On **dogs** it usually operates both as an emetic and cathartic. Small and freely diluted doses increase the secretion of urine and the proportion of urinary solids. On **pigs** it acts as a purgative, but is scarcely so safe or certain as oil, jalap and calomel, or aloes.

Toxic Effects.—In the *Veterinarian* for 1839 and 1862, cases are recorded of **pigs** eating about four and a half ounces, repeated during several days. They suffered from flatulence, diarrhœa, vertigo, convulsions, and paralysis, and died in eight to twenty-four hours. The mucous membrane of the stomach and bowels was found after death highly injected and inflamed. Dr Charles Cameron, Professor of Hygiene, Royal College of Surgeons, Dublin, in 1871 reported the poisoning of thirty-one pigs conveyed by rail in a salt truck, from the sides of

which they had licked the salt. For many hours they had been deprived of water. They appeared in a state of asphyxia; emetics and subsequently stimulants were ordered, and eleven recovered. The carcases of those that died exhibited "signs of gastro-intestinal inflammation; the brain was greatly congested, and there was considerable extravasation of blood in the cerebellum and medulla" (*Veterinarian*, December 1871). Even **cattle and sheep,** for which it is generally a suitable cathartic, occasionally **suffer from overdoses.** I have seen dangerous effects produced by several ounces given to young and delicate calves, for which oil is a more suitable purge. Mr Dobson, of Ashby-de-la-Zouch, reports that one-pound doses given in four quarts of water to healthy yearlings in half an hour induced irritation, excitement, staggering, paralysed hind quarters, and death (*Veterinarian*, April 1865).

Nitrate of soda, much used as a manure, has irritant and cathartic properties, somewhat resembling those of common salt; has sometimes injured both horses and cattle that have licked it, or eaten grass strongly saturated by a large recently applied dressing ("Nitre," p. 543, and *Veterinarian*, September 1876).

Medicinal Uses.—For vigorous **adult cattle** and **sheep,** common salt is a very **useful purgative,** resembling in its effects Epsom and Glauber salts. It is, however, more soluble, moderate doses are more quickly absorbed, and hence it is frequently desirable to **conjoin common and Epsom salts.** Full doses of such salines cause thirst, induce the animal to drink water or other bland fluids freely, thus softening and carrying onwards the hard, dry, impacted food, so apt to accumulate in the first and third stomachs of ruminants. For such patients salt is administered to unload the bowels in distension of the rumen with food, in fardel-bound, as well as in the earlier stages of diarrhœa depending on over-feeding, or kept up by the presence of irritating matters in the canal. It is given to relieve irritation and inflammation of the eyes, brain, respiratory organs, or limbs; and in such cases not only beneficially empties the stomachs and bowels, but frees the blood of peccant matters, and excites counter-irritation. It controls excessive action of silver salts.

Small and repeated doses are **stomachic,** and are prescribed with gentian, ginger, or spirits and water, for all animals suffering from indigestion and irregular appetite. It obviates in some measure the evil effects of damp and badly kept fodder, and, given with nutritive dry food, prevents or retards the progress of liver-rot in sheep. Systematically given, salt lessens the liability to intestinal worms, and an injection of two or three ounces to a pint of water often brings away ascarides from the rectum. It is a common addition to laxative clysters.

Dissolved in 10 to 20 parts of water, it proves a serviceable **antiseptic and stimulant gargle** in relaxed and ulcerated sore-throat of horses and other patients; such an application increases the activity of the cilia of the bronchial mucous membrane. Salt-water baths exert curative effects on animals as well as on man (p. 132). For stuping or cleansing wounds, or even bruised surfaces, a 1 per cent. watery solution, used hot, in virtue of its stimulant and antiseptic properties, is preferable to plain water, and less apt to sodden or weaken the vitality of the parts. Salt solutions are applied cold as **stimulants** and **refrigerants** for strains and chronic inflammation of the joints and feet, particularly amongst cattle and sheep. Where a cooling mixture is required, 1 part each of salt nitre and sal ammoniac is dissolved in 30 to 40 parts of water; or 1 of salt is mixed with 2 of pounded ice. Such freezing mixtures require, however, to be used warily, for their prolonged application dangerously lowers vitality.

For **preventing and arresting putrefaction,** salt is cheap and effectual. Dr Angus Smith found that one hundredweight of night soil was preserved for thirty-four days, with scarcely any putrefaction, by two ounces of salt (*Cattle Plague Reports*). For antiseptic purposes, salt is advantageously conjoined with carbolic acid. To disinfect skins and other such animal matters, a pound of salt and two ounces of carbolic acid are used, dissolved in a gallon of water. Waste chlorides, known as Cooper's salts, are used to preserve for manure the meat seized at the Metropolitan markets as unfit for human food.

Doses, etc.—As a purgative, the adult ox or cow takes lb. $\frac{3}{4}$ to lb. j.; sheep, ℥j. to ℥iij. Instead of using common

salt by itself, I prefer—as more prompt and effectual—half-doses of common and Epsom salts, dissolving the mixture in about two quarts of tepid water, and with two ounces of powdered ginger, anise, or other aromatic, adding a pound of treacle. When the mixture is thus sweetened, some cattle readily drink it, and the trouble of putting it over may be saved. In treating gastric derangements and other cattle cases, accompanied by torpidity of the bowels, it is sometimes necessary to hasten and increase the effects of salines by addition of other purgatives. Along with lb. $\frac{1}{2}$ each of common and Epsom salts, dissolved in water with the usual proportion of aromatics and treacle, addition may be made of calomel, ʒi. to ʒij.; 20 croton beans; or gamboge, ℥ss. to ℥j. Where such a dose fails to act in twelve or fifteen hours, it may be again repeated, or a pint or two of linseed oil may be substituted for the salts. Frequently reiterated, large doses of drastic physic are, however, to be avoided, for they induce nausea and depression, which prevent purgation. When a patient has got two, or at very most three, full doses of physic without effect, he should have frequent clysters, plenty of treacle, and as much salt and water, or simple water, as he will drink of his own accord, but rarely any more active cathartic medicine.

As a **stomachic** and **alterative** for horses or cattle, one or two ounces of salt are given, usually united with aromatics, bitters, or vegetable tonics. As an **emetic** for the dog, the dose varies from one to four drachms, dissolved in tepid water. A still more effectual readily-obtained emetic for a medium-sized dog consists of a tablespoonful of salt, and half a teaspoonful of mustard-flour, dissolved in three or four ounces of water. More prompt results are secured by adding a grain of zinc or copper sulphate, or a grain of tartar emetic.

SODIUM CHLORATA. Chlorinated Soda. Liquor Sodæ Chlorinatæ. Hypochlorite of Soda.

Admixture, and subsequent filtration, of solutions of sodium carbonate and chlorinated lime, produce the B. P. **liquor sodæ chlorinatæ,** known also as Labarraque's disinfecting fluid.

It is a colourless alkaline liquid, with an astringent taste, and a feeble odour of chlorine. Like the analogous solution of bleaching powder, it contains chlorides, chlorates, and hypochlorites, and, acted on by air or acids, gives off chlorine and chlorine compounds.

Actions and Uses.—It is antiseptic, stimulant, and antacid, and is also used as a disinfectant and deodorant. It is applicable to the same purposes as solution of chlorinated lime and liquor chlori.

It arrests the action of yeast and other ferments, and kills bacteria. It has been credited, when administered internally, with the power of oxidising urea and other products of tissue metamorphosis, and of hastening their excretion ; and outside the body it certainly oxidises such substances (*Dr John Harley ; Royle's Mat. Med.*) It has been prescribed in febrile cases and purpura in horses, and as an antidote for poisoning by hydrogen sulphide, the hydro-sulphides, and prussic acid.

It is chiefly serviceable as an **external antiseptic** for deodorising foul wounds and ulcers, checking excessive noisome discharges from the skin or mucous surfaces, controlling the earlier stages of eczema and prurigo, and for douching from an atomiser relaxed and irritable sore-throat. As an antiseptic, although more expensive, it is for some purposes preferable to chlorinated lime, inasmuch as, upon exposure, it becomes converted into common salt—itself a valuable antiseptic, and more permanent and convenient than the deliquescent, moist calcium chloride, which remains when bleaching powder is used.

Doses, etc.—Of the B. P. solution, which contains about $2\frac{1}{2}$ per cent. of available chlorine, horses and cattle take f℥j. to f℥ij. ; sheep and pigs, fʒj. to fʒij. ; dogs, ♏xv. to ♏xxx. dissolved in water.

SPERMACETI.

CETACEUM. A concrete fatty substance obtained, mixed with oil, from the head of the Sperm Whale, Physeter macrocephalus. It is separated from the oil by filtration and pressure, and afterwards purified. (B. P.)

Spermaceti is found in the cells of the large quadrangular head of the sperm whale, which inhabits the Pacific and Indian Oceans. It is extracted by openings made through the skull, and occasionally by boiling the cellular and adipose tissues, which do not, however, yield it so abundantly as the head. Purified by melting, straining, and solution in weak potash ley, it is a translucent, pearly-white, crystalline fat, with the density ·940, tasteless, odourless, tough, and difficult to powder, unless previously moistened with a few drops of rectified spirit. It is insoluble in water, sparingly soluble in cold alcohol, readily soluble in hot alcohol, chloroform, and oils, and melts at 110° to 122° F. Along with a little sperm oil, it consists of cetyl palmitate, which, unlike ordinary fats, is saponified with some difficulty, does not yield glycerin, but forms, when heated with an alkali, the crystalline ethal or cetyl alcohol ($C_{16} H_{33} OH$), and an alkaline palmitate.

ACTIONS AND USES.—It is emollient and demulcent, resembles wax, is rarely given internally, but is used for imparting consistence to ointments and plasters.

SPIRIT OF NITROUS ETHER.

SPIRITUS ÆTHERIS NITROSI. Sweet Spirit of Nitre. A spirituous solution containing nitrous compounds, aldehyd, and other substances (B. P.) An alcoholic solution of ethyl nitrite ($C_2 H_5. NO_2$), containing 5 per cent. of the crude ether (U. S. P.)

When rectified spirit, sulphuric and nitric acids are heated with copper wire, the nitric acid radicle (NO_3) is deoxidised by the copper; the resulting nitric peroxide or nitrous acid radicle (NO_2) displaces the hydroxel in the alcohol ($C_2 H_5. HO$), and

there is formed ethyl nitrite ($C_2 H_5 . NO_2$), which distils over with a portion of the alcohol. This saline ether, when diluted with about three times its bulk of rectified spirit, constitutes sweet spirit of nitre. In this process, which requires to be conducted with various important practical safeguards, complicated reactions occur, but the ultimate results are represented by the formula :—

$$\underset{\text{Alcohol.}}{C_2H_5HO} + \underset{\text{Nitric Acid.}}{HNO_3} + \underset{\text{Copper.}}{Cu} + \underset{\text{Sulphuric Acid.}}{H_2SO_4} = \underset{\text{Copper Sulphate.}}{Cu\,SO_4} + \underset{\text{Water.}}{2H_2O} + \underset{\text{Ethyl Nitrite.}}{C_2H_5NO_2}$$

PROPERTIES AND TESTS.—Sweet spirit of nitre is transparent and nearly colourless, with a very slight tinge of yellow; it is mobile, inflammable, of a peculiar penetrating, apple-like odour, and sweetish, cooling, sharp taste. Its specific gravity is ·840 to ·845. It effervesces feebly, or not at all, when shaken with a little sodium bicarbonate, indicating absence of acid. Agitated in a test-tube with solution of iron sulphate and a few drops of strong sulphuric acid, poured down the side of the tube, a deep olive-brown or black zone is produced, owing to the formation and solution of nitrous acid gas. A good freshly-prepared B. P. specimen should yield seven times its volume of this nitrous gas; and even when kept should not yield less than five times its volume. A weaker spirit of nitre, producing not more than five volumes of gas, is sold. Many veterinarians obtain from the wholesale chemist **nitrous ether** of guaranteed strength, and dilute it, as required, with spirit of such sort and strength as they desire.

ACTIONS AND USES.—Sweet spirit of nitre is stimulant, diaphoretic, and diuretic. Large doses are narcotic. Externally it is refrigerant and antiseptic. It conjoins the actions of the ether and alcohol of which it consists (pp. 381 and 194).

It is used for all animals as a **carminative** and **antispasmodic** in indigestion, tympanitis, and colic; as a convenient **cardiac and general stimulant** in typhoid cases and convalescence from debilitating disorders; and as an **excitant** of the skin and kidneys in simple febrile colds and rheumatism. It is **excreted** by the lungs, skin, and kidneys, increasing their secretions.

DOSES, ETC.—As a stimulant and antispasmodic, horses take f℥j. to f℥iij.; cattle, f℥j. to f℥iv.; sheep, fʒij. to fʒiv.; pigs, fʒj. to fʒij.; dogs, ♏xv. to fʒj. As it is readily decomposed, even by water, it should not be diluted or mixed with other medicines until immediately before it is administered. It is usually given in cold water, beer, or linseed tea.

For **antispasmodic** purposes, it is conjoined with opium, belladonna, hyoscyamus, or chloral hydrate. For colic in horses, two to four ounces are given with two or three drachms of aloes, one to two ounces of laudanum being often advantageously added, and the whole dissolved in a pint of cold gruel, ale, or water. Two to four ounces of the spirit, with about half the dose of laudanum, repeated every hour, counteract the spasmodic pains which occasionally follow parturition in cows. As a **general stimulant** in catarrhal fever and typhoid ailments in horses, two ounces each of sweet spirit of nitre and ammonium acetate solution are conjoined with a drachm of belladonna extract. The good effects are sometimes maintained by addition of a couple of ounces of whisky or rectified spirit, and by repeating the draught at intervals of two or three hours. **To combat serous exudations** in horses or cattle, two or three ounces of spirit of nitrous ether are usefully conjoined with half a drachm each of iodine and potassium iodide. **Diuresis** is determined by combination with nitre or oil of turpentine. **Diaphoresis** is developed when the patient is kept well clothed in tolerably warm quarters, and the medicine given in small and frequently-repeated doses.

For **dogs** with catarrh or sore-throat, a soothing **febrifuge draught** is made with two ounces spirit of nitrous ether, an ounce spirit of camphor, and three ounces cold linseed tea, treacle and water, or solution of liquorice extract; the dose ranging, according to the size and condition of the patient, from two to four fluid drachms.

SQUILL.

Scilla. The bulb of Urginea Scilla, divested of its dry membranous outer scales, cut into slices, and dried. (B. P.) *Nat. Ord.*—Liliaceæ.

The large bulbs of this Mediterranean plant, when sliced and dried, have a faint odour and disagreeable, mucilaginous, bitter, acrid taste. The active principle is **a glucoside**—**scillain** or scillitoxin—which is soluble in water, acetic acid, and alcohol.

Actions, Uses, and Doses.—Squill and its active principle, in full doses, are irritants, causing vomiting and purging; absorbed into the blood, they lower the pulse-rate and raise blood-pressure; they are expectorant and diuretic. They resemble digitalis in paralysing voluntary muscle, acting as heart-tonics, and producing diuresis. Squills are prescribed chiefly in those catarrhal and bronchial cases in which secretion is profuse. Professor Robertson gave horses the syrup in f℥ss. doses; dogs take ♏x. to ♏xx., conjoined with ipecacuanha, ammonium acetate solution, or camphor electuary. The acetate and tincture of squills are used in about half the dose of the syrup.

STARCH.

The farina or flour of seeds, soft cellular roots, and stems (*Royle*).

Starch is an important member of that dietetic series of **carbohydrates,** including gums and sugars, which contain at least six carbon atoms with hydrogen and oxygen in the proportion to form water. Starch is largely present in the cereal grains, in the stems of many plants, and in tubers, being stored in the seeds, and tubers for the nourishment of the young plants. **Wheat flour** contains about 70 per cent. of carbohydrates, chiefly starch, which receives the special title of amylum, 10 of proteids with water, and ash. **Oatmeal** contains 63 of starch and about 12·6 of proteids, with traces of a bitter amorphous alkaloid; **barley**, 64 starch, 12 proteids; rice, 83

starch, 5 proteids; **potatoes**, 21 starch, 2·8 proteids. From any of these sources pure starch is got by fine division of the grain or root; sometimes facilitating separation of other plant constituents by fermenting; washing the starch granules from fibrous matters, straining, and drying. The white starch, used for medicinal and dietetic purposes, is dried in powder or granules. The blue preferred for the laundry is in blocks, splits, as it dries, into columnar masses, is coloured by addition of a little indigo, and generally contains about 18 per cent. of water.

Arrowroot is the starch of the Maranta arundinacea; **sago**, the granular starch from the sago palm; **tous-les-mois**, the large ovular granules from the rhizomes of several species of Canna; **tapioca** or cassava is prepared from the expressed juice of the roots of Manihot utilissima. **Corn flour** or Oswego is the flour of Indian corn deprived of glutin by a weak solution of soda.

Starch consists of **round or oval grains** comprising a cell-wall enclosing concentric layers of granular matter. The large grains from potatoes are about $\frac{1}{300}$ of an inch in their long diameter, the small rounded grains of rice measure $\frac{1}{3000}$ of an inch. Starch grains from different sources differ in appearance when examined under the microscope. Wheat starch presents a mixture of large and small granules, which are lenticular in form, and marked with faint concentric striæ surrounding a nearly central hilum. Maize starch exhibits granules more uniform in size, frequently polygonal, smaller than those of wheat, having a very distinct hilum, but without evident concentric striæ. Rice starch has granules extremely minute, and nearly uniform in size, polygonal, the hilum small and without striæ. (B. P.)

Starch is insoluble in cold water, has the specific gravity 1·5, and hence is deposited when mixed with water. The cell wall consisting of cellulose, and the contained granulose are isomeric, having the formula usually given as $C_6H_{10}O_5$. When mixed with water above 120° F., the starch grains are burst and the granulose escapes, forming the viscid gelatinous mucilage used by the laundress. Such a solution when cold gives the characteristic **blue compound with iodine.** When

starch is boiled with diluted sulphuric or nitric acid it is converted into the isomeric but more soluble substance **dextrin** or British gum. One variety of dextrin gives a red colour with iodine. With further action of a weak acid and heat, the dextrin takes up water and is converted into **maltose** ($C_{12}H_{22}O_{11}.\ H_2O$) (p. 594), and eventually into **dextrose** ($C_6H_{12}O_6$) (p. 594).

When starch foods are eaten the unorganised salivary and intestinal ferments gradually crack the starch granules, and more quickly convert the starch through several forms of dextrin into maltose, and eventually into dextrose. These changes are also readily produced by mixing starch paste with crushed malt, the diastase of which develops the fermentative changes. **Animal starch**, or glycogen ($C_6H_{10}O_5$) present in the liver, in blood and in muscle, exhibits most of the characters of vegetable starch.

ACTIONS AND USES.—**Starch foods** are rapidly digested, especially when cooking or fermentation has cracked the starch cells, or when they have been thoroughly insalivated. Like other such proximate principles, pure starch cannot, however, alone support life for any lengthened period. A **properly** balanced **dietary** for horses or cattle should contain 1 part of albuminoids or proteids, along with 5 to 8 parts of starch or other carbohydrates. Active exertion, as in the case of hard-worked horses, or abnormal secretion as of heavily-milking cows, demands the larger proportion of albuminoids to replace their waste. Growing animals, in order to build up their tissues, require relatively larger supplies of albuminoids than suffice for adults. The starches—mostly converted into sugar—are consumed in the body more quickly and fully than fats. During their oxidation they are the great **source of animal heat,** especially in herbivora. They prevent wasteful consumption of the more costly albuminoids and fats. Under favourable conditions excess of carbohydrates are also believed to be directly concerned in the **formation of fat,** and Pasteur states that they furnish glycerin—the basis of neutral fats. For nutritive purposes 17 parts *(Voit)* to 23 parts *(Rubner)* of carbohydrates are equivalent to 10 parts of fat.

As a **demulcent and emollient,** starch mucilage protects and

softens irritable surfaces. In diarrhœa and dysentery it is used about the consistence of cream, at the temperature of 100° F., either alone or with laudanum, sugar of lead, or other astringents, and is given both by the mouth and rectum. It is an antidote for excessive doses of iodine. **Dry starch** is occasionally dusted over wounds and open joints to absorb discharges. Mixed with equal parts of zinc oxide it relieves irritation in the weeping earlier stages of eczema. United with carbolic acid or sanitas oil, it forms convenient desiccant antiseptics. 1 part of starch, heated with 5 of glycerin and 3 of water, makes a soothing demulcent. Starch is used for mixing and subdividing medicines, and as a vehicle for their administration. It is employed to stiffen bandages for surgical purposes.

STAVESACRE SEEDS.

STAPHISAGRIÆ SEMINA. The dried ripe seeds of Delphinium Staphisagria. (B. P.) *Nat. Ord.*—Ranunculaceæ.

Stavesacre or larkspur is a stout biennial herb, two to four feet high, growing throughout the south of Europe. Its officinal seeds are brown, wrinkled, irregularly triangular, about $\frac{1}{4}$ inch long and scarcely so broad; contain a white oily kernel; have a bitter, acrid, and nauseous taste, but are without any marked odour. The kernel yields one-fourth of its weight of a fixed oil. The seeds contain about 1 per cent. of several alkaloids soluble in ether and acetic acid, the most important being **delphinine,** which resembles aconitine, slowing the pulse and respiration, paralysing the spinal cord and killing by asphyxia; and **staphisagrine,** resembling curare, and paralysing the motor nerves and arresting respiration.

ACTIONS AND USES.—The seeds are used for the **destruction of lice,** and hence have been popularly termed louse seeds. An effectual parasiticide solution is made by boiling for an hour 1 part of seeds with 20 to 30 parts of water, and keeping it nearly boiling for an hour longer, making up the water to the quantity originally used. Such a solution rubbed into the skin not only kills pediculi, but also destroys their

eggs. Strong solutions, too freely applied, sometimes nauseate and prostrate delicate subjects. Occasionally they are conjoined with sulphur and tar.

STROPHANTHUS.

The seeds of Strophanthus hyspidus, used in Africa as an arrow poison. *Nat. Ord.*—Apocynaceæ.

The seeds are oval; have comose appendages; upwards of a hundred are found in the ripened follicles. They contain 8 to 10 per cent. of an active crystalline glucoside, **strophanthin,** which is soluble in water and rectified spirit.

ACTIONS AND USES.—The seeds and their active principle are **muscle poisons.** They augment the contractile power of striated muscles. They resemble digitalis, are **cardiac tonics,** increasing the length of the systole, slowing the rythm, and in fatal doses causing stoppage in systole. They have been used in human patients in mitral disease with dropsical symptoms. In horses and dogs they increase the length and volume of the first heart sound, strengthen and steady the enfeebled heart, and act as diuretics. Mr R. W. Burke, A.V.D., Jubbulpore, reports favourably of strophanthus in ischuria following inflammation of the kidneys in horses, and has used it with benefit in pityriasis occurring in tropical climates (*Veterinarian,* May 1888). Unlike digitalis, it does not seem to lose its effects by repetition, nor is it cumulative.

DOSES.—Of the tincture, made of one part of seed to 20 rectified spirit, horses take f℥ss. to f℥j., and dogs, ♏ij. to ♏vi.

SUGAR.

Sugar is present in many plants; is prepared in France and Germany from **white beet,** in Asia from various **palms,** and in America from **sugar-maple,** sorghum saccharatum, and **maize.** The sugar used in this country is chiefly got from the **sugar-cane** (Saccharum officinarum), which is extensively cultivated in the West Indies, has a perennial root, a jointed annual stem six to twelve feet high, and long grassy leaves,

which send out a flowering stem terminating in a panicle of beautiful silver-grey flowers. The lower parts of those canes which have not previously borne flowers are richest in saccharine matter. The canes are crushed between heavy rollers; the pale-green expressed juice, which contains nearly 20 per cent. of sugar, is mixed with a little slaked lime to neutralise acids and precipitate albuminoids, and concentrated in shallow vacuum pans, at a temperature not exceeding 140° F.; the coagulating albumin, entangling impurities, is skimmed off; the syrup is cooled in wooden vats, and dried in the sun, yellow dark-brown crystals of raw sugar are formed, and there drains away a variable quantity of brown uncrystallised molasses.

The raw brown or muscovado sugar in the condition imported often contains 40 per cent. of water and impurities, and is **refined** by solution in steam-heated water, mixed with a little milk of lime, animal charcoal, and occasionally with the serum of bullock's blood. Impurities thus coagulated rise to the surface and are removed; colouring matters are further got rid of by filtration through animal charcoal; the clear syrup is concentrated in vacuum boilers at about 170° F., quickly dried in small crystals, or poured into conical moulds and crystallised as loaf sugar. A cwt. of raw sugar yields about 80 lbs. refined sugar and 16 lbs. treacle.

There are two classes of sugars—(1) The **Sucroses** or Saccharoses, which when dry have the formula $C_{12}H_{22}O_{11}$, and (2) the **Glucoses**, with the formula $C_6H_{12}O_6$.

Sucrose, saccharose, or cane sugar ($C_{12}H_{22}O_{11}$), like sulphur and arsenious acid, has an amorphous and a crystalline form; its crystals are monoclinic prisms; its specific gravity, 1·606; it phosphoresces in the dark, and is dextrorotatory. It is insoluble in absolute alcohol, but soluble in one-third of its weight of water at 60° F. When slowly crystallised at about 170° F., by suspending threads in a strong watery solution, to which a little alcohol is generally added, bold prisms of sugar-candy are formed. A strong solution, evaporated and heated to 320° F., fuses, and the vitreous mass can be moulded into barley-sugar. Between 356° and 374° F., sucrose parts with two molecules of water,

loses its sweet taste, acquires a dark colour, and becomes caramel, which is used by confectioners and distillers as a colouring agent.

Sucrose in plants is gradually built up from the simpler glucose ($C_6H_{12}O_6$), and conversely when acted on by dilute acids or by ferments, such as diastase or yeast, it is again converted into glucose. Sucrose must undergo this change before it can yield alcohol.

Maltose ($C_{12}H_{22}O_{11}.H_2O$) is prepared by grinding starch with water, warming it until it gelatinises, and heating this with crushed malt, the diastase of which sets up fermentation, causing three molecules of starch to appropriate one of water, and yield one molecule of maltose and one of dextrine. Maltose is also formed during the digestion of starch by the ferments of the saliva, intestinal and pancreatic juices. It is soluble and readily fermented.

Lactose, or **milk sugar** ($C_{12}H_{22}O_{11}$), is prepared by **evaporating whey** to a syrup and setting it in a cool place to crystallise. It is obtained from the homœopathic chemists, who use it for subdividing their medicines. It occurs in translucent greyish-white hard cylindrical masses of rhombic prisms. It is gritty, and being less soluble is not so sweet as the vegetable sugars. It is not directly fermentable.

Glucose, dextrose, or grape sugar ($C_6H_{12}O_6$) is the crystallised sugar found in **grapes and other fruit** and in honey. It is obtained from cane sugar by prolonged boiling, or acting upon it with alcoholic solution of hydrochloric acid. It results when starch is boiled with water acidulated with sulphuric acid. It is the variety occurring in the blood and in the urine, and formed from starch whether in or out of the body. It is yielded by a number of vegetable principles termed glucosides, including salicin, amygdalin, and digitalin, when these are boiled with diluted acid. Glucose is neither so sweet nor so soluble as sucrose; it crystallises in six-sided scales, is not charred by sulphuric acid, but forms with it sulphosaccharic acid. It produces a readily crystallisable compound with common salt. Its **distinctive test** is a few drops of cupric sulphate solution, and enough caustic potash to make the liquid blue; when the mixed solutions are gently

heated, a red precipitate of copper suboxide goes down if glucose is present, but no reddening or precipitation occurs with pure sucrose unless the solution is boiled.

Lævulose, also termed fructose, is isomeric with dextrose, and is associated with it in most fruits. By keeping, and especially by exposure to light, the more soluble lævulose in fruits and syrups is gradually converted into the more crystalline dextrose. These two sugars are distinguished by the manner in which they turn a ray of polarised light. Lævulose is sweeter than dextrose, is not so readily fermentable, nor does it so easily reduce alkaline and cupric solutions.

Molasses, treacle, theriaca, or sacchari fæx, is the uncrystallised, fermentable, syrupy residue from the preparation and refining of sugar. It has a brown colour, a pleasant sweet taste, and a specific gravity of about 1·4. Molasses is the drainings from the raw sugar; treacle the darker, thicker residue from the moulding process.

Honey or **mel,** the saccharine secretion deposited in the honeycomb by the hive bee, when first collected, is yellow, translucent, and viscid, and consists of variable proportions of sucrose and lævulose. The popular household expectorant **oxymel** is made of eight parts of honey, liquefied by heat, and mixed with one part each of acetic acid and water.

Actions and Uses.—The sugars are members of the **carbohydrate series of dietetic substances** (p. 590), are digestible and nutritive; their important function in all the higher animals is the support of animal heat; they moreover economise the proteids and fats, and also directly contribute to the deposit of fat. As they cannot restore the waste of the albuminoid textures, they are inadequate, however, to support life for any lengthened period.

Medicinal Uses.—The sugars are laxatives, demulcents, and antiseptics, and are used pharmaceutically as excipients.

One or two pounds given to horses, or eight to twelve ounces to dogs, increase the amount and fluidity of the fæces, and usually also augment secretion of urine. As a **demulcent,** sugar is used in human practice in the dry stages of catarrh; in poisoning with salts of mercury and copper; and as a domestic remedy for wounds, and for removing specks on the

cornea. Its **antiseptic** properties recommend it for preserving many vegetable, and some soft animal, substances, and for making up various medicines. It increases the solubility of calcium salts (p. 287), and retards oxidation of ferrous compounds (p. 422). The **syrupus simplex,** used for flavouring, preserving, and suspending medicines, is made by dissolving, with the aid of gentle heat, five pounds refined sugar and two pints water, and adding after cooling sufficient water to make the weight of the product $7\frac{1}{2}$ lbs. The specific gravity is 1·330. (B. P.)

Molasses and **treacle** are often substituted for sugar. They are palatable, digestible, laxative articles of diet, useful for sick and convalescent animals. They are convenient **auxiliary purgatives,** and valuable for hastening the action, preventing the nausea, and covering the disagreeable flavour of active cathartics. Where full doses of physic have been previously given, and their repetition is inexpedient, large and repeated doses of treacle often encourage the action of the bowels, especially in cattle and sheep. As a soothing **antiseptic gargle** for horses, three or four ounces of treacle and an ounce of borax or of potassium nitrate or chlorate, are dissolved in a pint of water, and a few ounces slowly administered every hour or two, or when cough is troublesome; an ounce of belladonna extract is sometimes added. Treacle is a convenient antiseptic excipient for ball masses, imparting a proper consistence, and preventing their becoming dry, hard, or mouldy. The common mass, so largely used as an excipient, is made by thoroughly mixing with gentle heat equal weights of treacle and linseed flour.

DOSES, ETC.—Of sugar and treacle, as laxatives, horses and cattle take lb.j.; sheep, ℥iij. or ℥iv.; pigs, ℥ij. or ℥iij.; dogs, ℥i.; administered with aromatics and salines, usually dissolved in water, milk, or gruel, or mixed with a mash.

SULPHUR.

Sulphur, or brimstone, is a chemical element, and one of the most ancient articles of the Materia Medica. It occurs in many animal substances as sulphates, and notably in bile and

the albuminoids; in the strong-smelling volatile oils of the Cruciferæ and Umbelliferæ; in various mineral waters as hydrogen sulphide, and in the pyrites or metallic sulphides, from which it is extracted by roasting. The extensive supplies of sulphur required in the manufacture of sulphuric acid, sulphurous acid, gunpowder, lucifer matches, and vulcanised india-rubber, are, however, chiefly obtained from the **native sulphur,** occurring as a product of volcanic action in beds of blue clay in Sicily and Italy.

The crude sulphur is purified by distillation, and when run into wooden moulds forms the stick or **roll sulphur,** which is yellow crystalline, and so bad a conductor of heat that it often cracks when held in the warm hand.

Flowers of sulphur, also called sublimed sulphur, are prepared by distilling the crude sulphur, and conducting it in the state of vapour into large chambers, where it condenses in a fine yellow powder consisting of spherical granules.

Precipitated sulphur, or milk of sulphur, is prepared by boiling sublimed sulphur with slaked lime, when calcium sulphide and hyposulphite are formed, and when treated with diluted hydrochloric acid are decomposed, sulphur being precipitated in a finely divided white powder.

Sulphur Vivum, Caballum, or horse sulphur, the residue left in the subliming pots, must be used with caution, for, besides other impurities, it contains arsenic.

Properties.—Sulphur occurs in six allotropic forms, manifesting differences in physical condition, specific gravity, fusing point, solubility in carbon disulphide, and electric affinities. Most varieties have a yellow colour, a specific gravity of about 2·, have little or no taste, until heated are insoluble in water and cold alcohol, and usually are freely soluble in benzol, carbon disulphide, fixed and volatile oils. All varieties melt at 240° F., are entirely volatilised by heat, inflame at 500° F., burning with a pale blue flame, and giving off suffocating fumes of sulphurous anhydride (HO_2). When melted in a Florence flask the limpid amber-coloured fluid about 300° F. gradually gets darker and opaque, and so viscid that it adheres to the vessel even when inverted; above 350° F. heat becomes latent, the sulphur recovers its liquidity; and

about 500° F., if poured into cold water, it is so viscid and vitreous that it may be drawn into threads, but in a few hours this ductility disappears, latent heat is lost, and the mass returns to the normal brittle crystalline form. At 836° F. it boils, producing heavy red-brown vapours, which are liable to explode if mixed with air.

Sulphur unites with many other elements; with chlorine, iodine, bromine, and carbon; with metals to form sulphides; with hydrogen producing hydrogen sulphide; with oxygen forming a series of eight acids.

Actions and Uses.—Sulphur mechanically stimulates cutaneous and mucous surfaces to which it is directly applied, and hence is of service in relieving chronic passive congestion of the skin. It destroys parasites. Administered internally it is laxative and alterative.

General Actions.—It **destroys** the odium **fungus** on vines, and kills similar **parasites** affecting plants and animals. How much of this toxic effect depends on the sulphur acting as sulphur, and how much on the alkaline sulphides, sulphuretted hydrogen, and sulphurous acid, into which it is gradually converted, has not been determined. Sulphur when swallowed is mainly converted into sulphides, which stimulate the intestinal mucous membrane, while a further change is made into sulphuretted hydrogen, which imparts its disagreeable smell to the secretions of the skin, lungs, and bowels. The mutton of sheep receiving daily several ounces of sulphur is stated to acquire a distinct sulphurous flavour. A proportion of the sulphur administered is **excreted** in the urine as sulphates. The alkaline sulphides are sometimes substituted for sulphur, and like it are laxative and parasiticide (p. 537).

Toxic Actions.—One pound given to **horses** causes colic, purging, prostration, and sometimes fatal gastro-enteritis (*Moiroud*). A horse affected with glanders received doses beginning with an ounce, and gradually increased by additions of an ounce daily, until the sixteenth day, when he had got 136 ounces. Diarrhœa supervened on the seventh day; but appetite remained throughout unimpaired, the urinary secretion unaffected, the pulse and breathing normal. By the third day, the perspiration had a sulphurous smell, and a piece of paper

moistened with lead acetate, and laid on the skin, became grey. The muco-purulent discharge from the nostrils increased daily; the patient, though well fed, became gradually emaciated, and so debilitated, that by the seventh day he was unable to rise. After the tenth day, the blood, even in the arteries, became dark-coloured, thin, and slow to coagulate. On the seventeenth day the animal was destroyed. The mucous lining of the stomach, colon, and cæcum was reddish-blue, soft, and easily torn. The lungs, muscles, and intestinal contents smelt strongly of hydrogen-sulphide, but the blood had no such odour *(Hertwig)*.

Medicinal Uses.—Sulphur is given to the several domestic animals as a **laxative** where more powerful purgatives might irritate, as in pregnancy, chronic pulmonary disorders, convalescence from acute diseases, and in piles. Its **alterative** and **stimulant** effects on the skin have led to its use in rheumatism, eczema, and other cutaneous diseases. Some practitioners affirm that it benefits dry congested conditions of the respiratory membrane, by stimulating its epithelial cells, and increasing movements of the cilia (*Ringer*). It has no special vermicide action. The piece of roll sulphur so often placed in the dog's trough, being insoluble in water, has no effect in preventing, as is popularly believed, distemper and other canine disorders.

Although sulphur dusted on the skin has slight effect, when dissolved by admixture with an alkali, or oil, and smartly rubbed in, it stimulates the cells of the rete Malpighii, and thus hastens desquamation; while it also increases contractility of the muscular texture of the skin, and hence overcomes passive hyperæmia (*Dr W. Allan Jamieson, The Practitioner* for September 1881). It thus promotes a healthier action in chronic eczema and psoriasis; and in such cases sulphur dressings are frequently with benefit conjoined or alternated with iodine or tar acids, and aided by the internal use of sulphur and arsenic. Infriction of sulphur ointment is stated to relieve the pain of rheumatic muscles and joints.

For the prompt and effectual cure of **mange and scab,** it is essential to reach the burrows in which the female acari have deposited their ova, by diligent scrubbing with soft soap and

water. The thickened skin being thus softened, and scales removed, the sulphur dressing comes into immediate and fatal contact, not only with fully developed, but with embryo acari. In cases of long standing a second or even a third application at an interval of a few days may be requisite to destroy any acari which have been hatched since the former dressing. The destruction of the parasite appears to be effected by the hydrogen sulphide, eliminated when sulphur comes in contact with organic matter. Lethal effects are intensified by presence of alkali. Kückenmeister demonstrated that although acari lived for several days in sulphur ointment, they perished in fifteen minutes in mixtures of sulphur and potash. In intractable mange, complicated as it often is with hypertrophied and scaly skin, besides scrupulous attention to cleanliness and the internal use of arsenic and alkalies, it is desirable to vary the external application, using in turn sulphur, tar oils, and diluted mercurial ointments, which, penetrating deeply, reach the burrowing parasite.

Doses, etc.—As a **laxative,** horses take ℥j. to ℥iv.; cattle, ℥iij. to ℥vi.; sheep and pigs, ʒiv. to ℥j.; dogs, ʒj. to ʒiv. As an **alterative,** one-fourth of these doses suffices. The precipitated, being more finely divided than the sublimed, sulphur is somewhat more certain and active as a laxative. Sulphur is conveniently administered suspended in gruel, or treacle and water, or dissolved in milk or oil, and is often conjoined with aromatics, salines, or mercurials. For horses or cattle, a laxative mixture is made with one to two ounces each of sulphur and cream of tartar, dissolved in water, with half a pound of treacle; one-third of this dose suffices for sheep and pigs, one-sixth part for dogs. A convenient alterative for horses or cattle consists of an ounce each of sulphur and ginger, and half an ounce of nitre, repeated once or twice daily.

For external use, most practitioners have their own formula. The **ointment** usually consists of 1 part of sulphur and 4 of vaselin or lard; $\frac{1}{4}$th part mercurial ointment is sometimes added. A **liniment** is made with 1 part of sulphur and 6 or 8 of linseed or other common oil; 1 part of tar oil or of Barbadoes tar is often added. A useful **mange dressing** is made

with 2 parts of sulphur, 1 each of tar oil and potassium carbonate, and 10 or 12 of lard or oil. For mange, ringworm, and other itching skin complaints, few remedies are equal to sulphur iodide (p. 415). Inveterate cases of grease Professor Williams treats with 8 parts of sulphur, 4 potassium carbonate, 1 carbolic acid, with 32 each of lard and olive oil. The dressing is freely rubbed in, allowed to remain on for two or three days, and then washed off with soap and warm water. For itch papules and vesicles in human patients, Dr Tilbury Fox recommends a drachm of sulphur, 8 grains each of ammoniated mercury and creasote, 20 minims chamomile oil, thoroughly mixed with 2 ounces lard. This prescription answers well for similar cases in dogs.

SULPHURETTED HYDROGEN. Hydrogen Sulphide (H_2S).

This colourless, inflammable gas, characterised by its smell of rotten eggs, is given off from various mineral springs, from sewage, and from the putrefaction of organic matters. It is prepared by the action of diluted sulphuric acid on iron sulphide; and if the gas thus evolved is conducted into cold water, a solution is obtained which is in constant use as a chemical test.

TOXIC ACTIONS.—It is destructive both to plant and animal life. Its admixture in the air, arising not infrequently from the burning of imperfectly purified coal-gas, causes the leaves of plants to droop and become flaccid, and from such poisoning they never recover. Animals breathing such an atmosphere, resulting frequently from foul drains, undoubtedly suffer in general health. The soluble gas is liable to become **absorbed** by any of the mucous surfaces or the skin. In concentrated form, the gas reduces and **decomposes the hæmoglobin** of the blood, causing asphyxia, and leading to paralysis of the nervous centres and muscles. In rapidly fatal cases, the notable symptoms are those of asphyxia. Artificial respiration and douches, alternately of cold and warm water, with cautious inhalation of chlorine, are the fitting antidotes.

SULPHUROUS ACID.

ACIDUM SULPHUROSUM. Sulphur dioxide. A solution in water of 5 per cent. of Sulphurous anhydride (SO_2).

When sulphur is burned in air or oxygen, or when sulphuric acid is heated with charcoal, iron, copper, or other deoxidising bodies, there is given off a heavy, colourless, liquefiable, suffocating gas—sulphurous anhydride, popularly styled sulphurous acid (SO_2). This gas, in presence of moisture, or when passed into water, evolves heat, and is believed to become true sulphurous acid (H_2SO_3), which is crystallisable ($H_2SO_3 . 14H_2O$), unstable, and dibasic, and forms two classes of sulphites.

The B. P. solution is colourless, has a pungent sulphurous odour, reddens litmus, bleaches colouring matter, leaves no residue when heated, and has the specific gravity 1·025. It is distinguished by its pungent odour; when in combination it is liberated by hydrochloric acid. Both the gaseous and liquid forms are used as bleaching agents, especially for woollen and silk goods. Unlike chlorine, they do not destroy colouring matters, but form with them colourless compounds. They have a marked affinity for oxygen, undergoing conversion into sulphuric acid.

ACTIONS AND USES.—Sulphurous acid is antiseptic, disinfectant, and deodorant, and is used as a parasiticide. Concentrated doses, whether in the gaseous or liquid state, are irritant.

GENERAL ACTIONS.—A solution of 1 part in 8000 of water **destroys diastase** and **ptyalin**; but although smaller quantities arrest the action of emulsin and myrosin, 1 part in 1317 is required to destroy pepsin. Developed **bacteria are killed** by 1 part in 2000 of water; but to prevent reproduction of the spores, 1 part in 325 is needful. Sir Robert Christison found that $\frac{1}{5}$th of a cubic inch, diluted with 10,000 volumes of air, destroyed the leaves of plants in forty-eight hours. It prevents putrefaction of gelatin used in paper-works, and destroys the effluvia of the cochineal dye manufacture. Its antiseptic properties are shared by the sulphites and hyposulphites.

Medicinal Uses.—Dr Dewar, of Kirkcaldy, first showed its extended application in human medicine and surgery. With the several forms of solution, fumigation, and spray, he successfully treated colds in the head, sore throat, bronchitis, typhoid fever, as well as wounds. In rheumatism, he directed the bedclothes to be exposed to the vapours of burning sulphur, and laid over the patient, when refreshing perspiration was evoked. In analogous cases amongst the lower animals, sulphurous acid has also proved useful. Professor Robertson employed it at Camden Town in **influenza** cases where there was muco-purulent discharge from the upper air-passages. Professor Williams recommends its inhalation in nasal gleet. It is serviceable in those cases of **catarrh pharyngitis** and laryngitis in horses, in which the membrane is irritable and relaxed, and the discharges are profuse and noisome. It has been prescribed in hoven in cattle, and tympanitis in horses; but two-ounce doses of the B. P. solution do not yield the prompt relief which usually follows ammonia or ethereal solutions. In young calves, tympanitic from hasty or careless feeding, ounce doses more effectually arrest undue fermentation. For dogs, ♏ xxx. to ♏ lx., in water, **check gastric irritation** and **vomiting.** Calves and lambs affected by the **strongulus micrurus** have the parasite destroyed if they are placed in a loose box and made to inhale the gas, conveniently evolved from the burning of sulphur on red-hot charcoal. The production of the gas, if conducted six feet away from the patients, is sufficiently diluted before it is inhaled. Unless bronchial irritation is excessive, the animals should remain in the medicated atmosphere ten to fifteen minutes. Two fumigations, at intervals of a few days, usually effect a cure. The solution, used alone or with Sanitas fluid or glycerin, is a good **antiseptic dressing for wounds.** It is useful in the early irritable stage of psoriasis, especially in dogs. In mange and scab, the B. P. solution is used as a parasiticide.

Burning sulphur, used since the time of Homer, is still regarded an **effectual disinfectant.** Its free use is stated to have stamped out smallpox in Iceland in 1871, and arrested scarlet fever at Marlborough College in 1875 (*The Practitioner*, May 1877). Outbreaks of foot-and-mouth disease are be-

lieved to have been stayed by it. The gas is readily evolved in the stable or premises to be purified, by scattering flowers of sulphur over a few embers on a shovel or in a chauffer; and it burns best when previously mixed with about $\frac{1}{4}$th part of finely-divided charcoal. Where men or animals remain in the premises, care must be taken that the gas evolved is not in such quantity as to cause serious coughing or irritation. For each 100 feet of cubic space, $1\frac{1}{2}$ ounces of sulphur suffice. If it is to be used freely or repeatedly, articles of clothing should be kept out of its way, otherwise they get bleached, and eventually rotted, from the sulphuric acid condensed upon them. In tenantless buildings, the doors and windows should be closed, and gas evolved freely and allowed to permeate every corner; a fresh evolution may be made after a day's interval. During the prevalence of any epizootic of plague, pleuro-pneumonia, or foot-and-mouth disease in cattle, or of influenza or glanders in horses, or of distemper amongst dogs, further to protect healthy animals in the same or adjacent premises, they should breathe daily for half-an-hour the diluted acid, and should also be daily sponged with a weak solution, which will be rendered still more destructive to disease germs if mixed with a little carbolic acid. **Macdougall's disinfectants** contain sulphites and carbolic acid. Sulphurous acid and zinc chloride are the basis of **Tuson's disinfectants.**

DOSES, ETC.—Of the B. P. solution horses and cattle take f℥i. to f℥ij.; sheep and pigs, fʒss. to fʒj.; dogs, ♏xx. to ♏lx.; given every three or four hours, diluted with water or other cold bland fluid. It may be continued until the system is saturated and the skin gives off its odour. It is conjoined as required with aromatics, alcohol, ether, or opium. Dr Dewar believed this solution to be a more effectual antiseptic than either the sulphites or hyposulphites. But it must be freshly prepared and kept in well-stoppered bottles; when exposed to the air it oxidises and becomes irritant from formation of sulphuric acid. For surgical purposes, the B. P solution is diluted usually with three or four parts of water; with this the lint or other dressings are kept saturated; admixture with glycerin renders it more soothing. Baths are readily made by conducting the vapour of burning sulphur into water. Baths

or strong solutions are more effectual than fumigation in the treatment of mange and other skin complaints. For disinfectant purposes it may be used with carbolic acid, but not with chlorine or bleaching powder, which neutralise it.

TARAXACUM.

Taraxaci Radix. Dandelion root. The fresh and dried roots of Taraxacum officinale, collected in the autumn from indigenous plants. (B. P.) *Nat. Ord.*—Compositæ.

The dandelion abounds on British roadsides and waste places. The tap-shaped root is about 6 to 12 inches long, $\frac{1}{2}$ inch to 1 inch thick, is dark-brown externally, and white within; it is inodorous, but has a bitter taste. Its active principle is the bitter **taraxacin.**

Actions, Uses, and Doses.—Taraxacum has had a popular reputation as a blood purifier, liver stimulant, and remedy for jaundice. But Professor Rutherford's experiments accord to it only "a **feeble, hepatic, stimulant** action." In virtue of its bitterness, it is a mild gastric tonic, although seldom so serviceable as either gentian or calumba, and it has also slight laxative and diuretic effects. The fresh succus is the best preparation, and the dose for the horse is about f℥j, and for dogs fʒss. to fʒij.

THYME. THYMOL.

Thyme, the fresh leaves and twigs of Thymus vulgaris. *Nat. Ord.*—Labiatæ.

Thymol, a stearoptine obtained from the volatile oil of Thyme and other Labiatæ, and from various aromatic Umbelliferæ.

The Thymus vulgaris is a bushy evergreen shrub found in dry situations throughout Southern Europe. It derives its aroma from **an essential oil** separable into two parts—(1) the fluid **thymene**, which is isomeric with oil of turpentine ($C_{10}H_{16}$); (2) the solid **thymol** ($C_{10}H_{13}HO$, or $C_6H_3. C_3H_7. CH_3. OH$).

Thymol is also got from the Umbelliferous plant Carum

Ajowan, and from its several sources may be obtained either by fractional distillation and exposure of the distillate at a low temperature, or by saponifying the volatile oil with caustic soda and treating the resulting soap with hydrochloric acid. Thymol occurs in large oblique prisms. It requires for solution 1000 parts of water, but is more soluble in alcohol glycerin and alkaline solutions. It sinks in cold water; but when heated to 110° to 125° F., it melts and floats on the surface. A solution in half its bulk of glacial acetic acid, warmed with an equal volume of sulphuric acid, assumes a reddish violet colour.

Actions and Uses.—Thymol is antiseptic and disinfectant, diaphoretic and diuretic. Large doses paralyse the nerve centres of the cord and medulla. Its physiological actions place it between carbolic acid and oil of turpentine (*Brunton*).

Solutions of one per cent. **destroy bacteria** and prevent reproduction of their **spores.** Applied to the skin and mucous surfaces it causes irritation, followed by anaesthesia. When swallowed it is slowly absorbed. Dogs weighing 20 lbs. and rabbits weighing 7 lbs., receiving respectively 60 and 30 grains injected hypodermically, exhibited lowered blood-pressure and muscular weakness, paralysis of respiration and coma; but the fatal effect of full doses was frequently averted by artificial respiration. The respiratory mucous membrane was congested, the lungs were congested and sometimes consolidated, the kidneys inflamed, the urine albuminous, occasionally bloody. In **chronic poisoning** tissue metabolism appears to be impaired, and there is fatty degeneration of the liver, as in the case of phosphorous poisoning. It is **excreted** chiefly by the lungs and kidneys, imparting to the urine a green colour by direct, a brown by transmitted, light. **Compared with carbolic acid,** thymol is not so irritant, caustic, or poisonous; when absorbed it does not cause preliminary excitement, but from the first paralyses the nerve centres; as a disinfectant it is stated to be more powerful and permanent.

Medicinal Uses.—It has been prescribed in vesical catarrh, horses taking grs. v. to grs. xx.; dogs, gr. $\frac{1}{2}$ to grs. v. But its chief use is in **antiseptic surgery.** Notwithstanding its greater cost, it is sometimes substituted for carbolic, sali-

cylic, or boric acids. For allaying irritation and removing scales in chronic eczema and psoriasis, one to two grains are dissolved in an ounce of diluted spirit or of potassium carbonate solution. For such purposes an ointment is also used, made with 8 to 10 grains to the ounce of vaselin. As a stimulating antiseptic in sore throat and ozæna, it is used in the form of gargle, spray, or inhalation. It is the active constituent of **Volckmann's Antiseptic Fluid,** which, with one part thymol, contains 10 of alcohol, 20 of glycerin, and 100 of water.

TOBACCO.

TABACI FOLIA. Leaf Tobacco. The dried leaves of Nicotiana Tabacum. (B. P.) *Nat. Ord.*—Atropaceæ.

Tobacco derives its name from tabac, the instrument used by the American aborigines for smoking the leaf, from the island of Tobago, or from the town of Tobasco in New Spain. It appears to have been cultivated from time immemorial in America; and is now grown largely in the region watered by the Orinoco, in the United States, and in many temperate and subtropical countries of both hemispheres. It was unknown in the Old World, at all events in Europe, until after the discoveries of Columbus; and was first introduced into England by Sir Francis Drake in 1586. About fifty million pounds are annually imported into the United Kingdom, more than one-half being from the United States.

The Nicotiana Tabacum, which yields the Virginian and several commercial tobaccos, is an herbaceous plant, three to six feet in height, with a branching fibrous root, a tall annual stem, funnel-shaped, rose-coloured flowers, and large, moist, clammy, brown leaves, mottled with yellow spots, covered with glandular hairs, and distinguished by a strong peculiar narcotic odour, and a nauseous, bitter, acrid taste. The leaves readily communicate their properties to hot water and alcohol. The plant is cut down in August, and the leaves dried, twisted, and carefully packed, with great compression, in hogsheads. For many purposes the midrib is removed, and occasionally the leaf is fermented, in order to remove albuminous matters,

which, when smoked, give rise to oils and unpleasant products. Sugar and liquorice are sometimes added to impart mellowness and pliability.

The several manufactured tobaccos owe their peculiarities chiefly to the manner in which they are prepared; the unmanufactured Virginian, being strongest, is generally preferred for medicinal purposes. The leaves for making **cigars** are moistened with salt before being rolled into cylinders. **Snuff** is prepared by cutting tobacco into small pieces, piling it in heaps, and freely wetting it to encourage fermentation. The process continues during 18 to 20 months; the albuminoids of the leaf meanwhile undergo decomposition, with production of ammonium carbonate, volatile oil, as well as ethers and acids of the acetic series. The fermented product is ground and sifted.

Commercial tobaccos **contain** about 12 per cent. of moisture, 20 to 25 of lignin, and nearly the same amount of inorganic matters, chiefly salts of potassium and calcium. The chief active principle is **nicotine** ($C_{10} H_{14} N_2$)—a colourless, volatile, inflammable, oily alkaloid, with an acrid odour and taste. It occurs in combination with malic acid, constitutes 5 to 7 per cent. of the dried leaf, the larger amount being present in the best Virginian sorts. It is soluble in water, alcohol, ether, the fixed and volatile oils. Tobacco also yields, when distilled with water, a crystalline volatile oil—**nicotannin,** or tobacco camphor—produced from oxidation of the nicotine. Tobacco slowly burned, as when smoked, is decomposed, and **the smoke** accordingly contains various oils, acids, and ethers, while the nicotine has in great part been converted into two alkaloids of the benzine series—namely, pyridine ($C_5 H_5 N$) and collidine.

ACTIONS AND USES.—Tobacco and nicotine stimulate and then paralyse the motor nerves of involuntary muscles and the secreting nerves of glands. They enfeeble the circulation, cause muscular relaxation, and death results from respiratory failure. Tobacco is rarely prescribed internally, but is used externally as an antiparasitic.

GENERAL ACTIONS.—Moderate doses produce **motor excitement,** exhibited in twitchings and cramps, and followed by **muscular relaxation.** The vagus roots and its ends in the heart are stimulated, slowing the pulse; but subsequently, and

in larger doses, the vagus is paralysed and the pulse quickened. Blood-pressure, which falls with the lowered pulse-rate, subsequently rises from contraction of the peripheral vessels. **Poisonous doses** produce gastro-intestinal irritation, with vomiting in some animals and nausea and prostration in all. The secretions of the skin, bowels, and kidneys are increased. Convulsions occur, produced by imperfect aeration of blood, and death results from **respiratory arrest.** These effects are determined by whatever channel the poison is introduced into the body ; dogs dressed with concentrated decoctions frequently suffer from nausea and vomiting, while several human patients have been poisoned by enemata (*Brunton*).

Tobacco-smoke contains, as stated, pyridine and collidine. The former is the more active, and is more largely present in the smoke from pipes than in that from cigars. These products confer on tobacco-smoke antiseptic properties, but when concentrated, cause exhaustive convulsions and paralysis of the respiratory centres.

Toxic Effects.—Hertwig investigated the action of tobacco on the lower animals. He gave horses half an ounce to an ounce of the powdered leaves, with the effect of lowering the pulse three to ten beats per minute, and rendering it irregular and intermittent; while a repetition of such doses increased evacuation both of fæces and urine. Large doses, especially when injected into the veins, accelerated the pulse, increased action of the bowels and kidneys, and caused irritability and restlessness. A healthy middle-aged **cow** received two ounces dissolved in water, in divided doses, but given within two and a half hours. The temperature of the skin was heightened ; the pulse raised from 65 to 70 ; the breathing quickened and somewhat oppressed ; the pupil dilated, while perspiration was abundant. Next day the animal continued dull, but by the third day she was perfectly well. **An ox** consumed about four pounds of tobacco leaves, and speedily became very restive, ground his teeth and groaned, lay with outstretched limbs and distended rumen, passed quantities of thin fœtid fæces, and died in eleven hours in convulsions. The leaves were found in the alimentary canal, and the mucous membrane, especially of the fourth stomach, was red and

eroded, particularly where in contact with the tobacco. Hertwig further mentions that **goats** are similarly affected by one or two ounces, and generally die in about ten hours.

Orfila administered to a **dog** 5½ drachms powdered tobacco (rappee), ensuring its retention by ligature of the œsophagus. There ensued violent efforts to vomit, nausea, purging, tremors of the extremities, giddiness, accelerated respiration, quickened pulse, convulsions, stupor frequently interrupted by spasms, and in nine hours death. Convulsions and stupor are dependent on imperfect oxygenation of the blood, and not on direct action on the brain. A decoction containing half a drachm, injected into the rectum of a dog, produced similar symptoms, but was not fatal. Two and a half drachms, applied to a wound, destroyed a dog in an hour. The pupils are contracted, and in fatal cases are insensible to light. A single drop of **nicotine** destroys small dogs and rabbits in five minutes, producing convulsions and general paralysis.

Post-mortem discloses appearances of asphyxia; and in cases where the crude drug has been swallowed, and has not been immediately fatal, the gastro-intestinal tract exhibits evidences of irritation.

The **treatment of poisoning,** when the crude drug has been swallowed, consists in the use of the stomach-pump or emetics. Tannin renders nicotine insoluble. Keeping the patient warm, and the cautious administration of stimulants, antagonise nausea and depression; while artificial respiration, and the careful hypodermic injection of strychnine, overcome the tendency to death by asphyxia.

Tobacco is **allied to several other motor depressors** of the Solanaceæ, notably to dulcamara and belladonna; but it does not produce that peculiar disturbance of the locomotor centres, and consequent irregular movements, which characterise belladonna; while it increases, instead of diminishing, cutaneous and other secretions, and contracts instead of dilating the pupil. It resembles lobelia or Indian tobacco—the dried flowering herb of Lobelia inflata, which is sometimes prescribed for the relief of spasmodic asthma in dogs as well as in human patients. Tobacco is more limited in its paralysant effects than hemlock, prussic acid, or physostigmine.

Medicinal Uses.—Tobacco is not now administered internally. There are many better and safer emetics than the quid of tobacco sometimes given to the dog, and many more effectual remedies for intestinal worms. Tobacco **smoke clysters,** conveniently given by filling a common barrel-syringe by smoke drawn from a well-charged lighted clay pipe, were formerly used to relieve the spasms of colic, of strangulated bowels, as well as contraction of the neck of the bladder, and occasionally of tetanus; but chloroform, opium, and other anodynes are more effectual. A freely-diluted decoction, used as an enema, brings away ascarides lodged in the rectum.

Externally it is used to **kill** the **acari** of mange in horses and dogs, and of scab in sheep; while it also effectually **destroys lice, fleas,** and **ticks.** Although strong solutions, liberally applied, are apt to cause nausea, trembling, tetanic spasms, and sometimes death, there is no danger in the careful use of decoctions diluted with 30 or 40 parts of water. For **sheep** a wash or dip, effectual in destroying ticks, warding off for a considerable time attacks of flies, and not injurious to the colour or texture of the fleece, is made with one pound each of tobacco, sulphur, potashes, and soft soap, dissolved in 30 gallons of water, part of which, as in other dips, may be used hot. For such purposes the tobacco is previously boiled for fifteen minutes in a couple of quarts of water, and the decoction mixed with the other ingredients. These quantities suffice to dip thirty lambs or a score of bigger sheep. For the destruction of **scab acari,** a decoction of double the strength is used mixed with crude carbolic acid or naphtha, or with corrosive sublimate solution, and cautiously applied to every rough itching spot from a bottle with a fine quill perforating the cork.

TURPENTINES.

Terebinthinæ. *Nat. Ord.*—Coniferæ.

The Coniferæ yield the following drugs—

I. **The oleo-resinous juices** exuding spontaneously or from incisions made into the trunks or branches, consisting of common

and Venice turpentines, Canada balsam, Frankincense, and Burgundy pitch.

II. **The oil of turpentine**—the volatile or essential oil procured from turpentines by distillation ($C_{10}H_{16}$).

III. **The resins**—the residue of the distillation of turpentine.

IV. **Tar and pitch**—got by subjecting the roots and wood to destructive distillation.

I. The Turpentines or Coniferous oleo-resins.

The terebinthinate juices while recently exuded are fluid, or nearly so; but exposure to the air volatilises and oxidises their essential oil, and they solidify. They have a peculiar pungent bitter taste and odour, are scarcely soluble in water, are partially soluble in rectified spirit, are soluble in oils, ether, and alkaline solutions; are inflammable, and leave, when burnt, a finely-divided residue of carbon or lamp-black. Several of the more important varieties demand notice.

Common or **Horse Turpentine** is obtained throughout the southern states of America from Virginia to the Gulf of Mexico, chiefly from the Pinus Tæda and P. palustris australis or swamp pine—a tree 60 or 70 feet high, having bright green linear leaves about a foot in length, and collected into bundles like those of the Pinus sylvestris, or Scotch fir, from which throughout northern Europe turpentine is also procured. During winter or early spring one to four holes are cut in the bark of each tree, and pockets or boxes are attached, capable of holding about a quart of juice. Between May and September the bark above each box is hacked every eight or ten days, in order to tap the oleo-resin cavities and ducts, which in this species lie chiefly between the wood and bark.

In the south-west of France, the **Bordeaux turpentine,** chiefly from Pinus maritima and P. pinaster, is got by bleeding or hacking the bark, and conducting the juice into suitable vessels placed at the foot of the tree. The annual yield of each tree ranges from 12 lbs. to 20 lbs. The trees continue productive for upwards of fifty years (*Flückiger and Hanbury*).

Turpentine from different sources differs somewhat in

appearance; the American is dextrogyrate, the German lævogyrate; it is semi-fluid; its consistence varies with the temperature; it gradually solidifies from escape and oxidation of the volatile oil; it has a yellow colour, an aromatic odour, and a warm pungent taste. Unless melted and strained it usually contains leaves, twigs, and other impurities. Water acquires its flavour, but separates only traces of its active principles. Rectified spirit and ether dissolve it; eggs and mucilage form with it emulsions convenient for administration. The crude American variety, when recent, yields 15 to 25 per cent. of essential oil ($C_{10}H_{16}$).

VENICE TURPENTINE (Terebinthina Veneta), chiefly extracted in the Tyrol, Switzerland, and Piedmont, is got from the common larch, the Abies, or Larix europæa—a lofty tree with graceful drooping branches, and leaves at first in fasciculæ, like the pine tribe, but afterwards becoming solitary by elongation of the twigs. In winter or early spring a hole is bored reaching the heart wood, in which the turpentine mostly occurs; the hole is then plugged, and when opened in autumn about a pound of honey-like juice is removed and purified by filtration. It is tenacious, rather opaque, and fluorescent; less apt than common turpentine to concrete with keeping; has a pale yellow colour, an acrid bitter taste, a disagreeable terebinthinate odour, and contains 15 per cent. of oil of turpentine. The Venice turpentine of the shops almost invariably consists of about three parts of black resin dissolved in one part of oil of turpentine. This artificial mixture is distinguished by its strong odour, and its more quickly evaporating, and leaving a varnish on a sheet of paper, on which the natural Venice turpentine remains viscid.

CANADA BALSAM, chiefly brought from Lower Canada, is obtained by making incisions into the bark or puncturing the special vesicles lying between the bark and wood of Pinus or Abies balsamea. It is a pale greenish-yellow oleo-resin of the consistence of thin honey, has an agreeable balsamic terebinthinate odour, and a slightly bitter, feebly acrid taste. On exposure it drys slowly into a transparent adhesive varnish, and solidifies when mixed with one-sixth of its weight of magnesia. (B. P.) It contains 15 to 18 per cent. of oil, is

much used by varnish makers, opticians, and microscopists, and with collodion and castor oil constitutes **flexible collodion.** It is sometimes improperly termed Balsam of Gilead, which, however, is derived from an Arabian balsamodendron. **Strasburg turpentine** is a fluid citron-smelling oleo-resin obtained in the vicinity of the Alps from Abies picea. **Chian or Cyprus turpentine,** from the island of Scio, nearly resembles Canada balsam in its properties and uses; is a greenish-yellow liquid oleo-resin from the Pistacia terebinthus, a tree of the mastic order.

FRANKINCENSE, gum thus or Thus Americanum, is the semi-opaque, soft, concrete turpentine scraped from the hacked bark of the Pinus palustris, P. Tæda, and other American coniferæ, and which, by exposure, has lost a portion of its volatile oil. A similar concrete turpentine comes from the south of France, under the name of gallipot or barras.

BURGUNDY PITCH is the resinous exudation from the stem of the Pinus picea or spruce fir, melted and strained. It consists of an amorphous resin, oil of turpentine, and other isomeric oils, and abietic acid. It occurs in semi-opaque reddish-brown masses, breaks with a shining conchoidal fracture, and has an empyreumatic turpentine odour and aromatic taste. The substance sold as Burgundy pitch is generally made by melting resin and palm oil, and stirring in some water. True Burgundy pitch and its imitations spread upon leather are used for stimulant and adhesive plasters, applied in swellings of joints, chest affections, and rheumatism.

ACTIONS AND USES.—The turpentines are **topical irritants.** When swallowed they are speedily absorbed, act as **general stimulants,** and are discharged by the kidneys, bronchial membrane, and skin, stimulating the channels employed in their excretion. Their uses resemble those of their more active constituent, oil of turpentine (p. 616). In percentage of oil, and hence in activity, they stand as follows: Canada balsam, Venice turpentine, common turpentine, and frankincense. They are occasionally **used as stimulants** in indigestion, colic, and general debility; as **laxatives**, especially when in combination; and as **anthelmintics, diuretics,** and **inspissants** of mucous discharges.

Externally applied they are **stimulants, astringents,** and **antiseptics,** and are used for making up diuretic and stimulant balls. In the south of France the resinous vapours of the Coniferæ have been successfully employed by human patients for the relief of bronchitis, phthisis, and rheumatism. The growing pine-forests, and the oleo-resins extracted from them in presence of oxygen, evolve antiseptic camphorous oils and peroxide of hydrogen, which purify the air and destroy disease germs (p. 561).

DOSES, ETC.—Horses and cattle take ℥j. to ℥iij.; sheep, ʒj. to ʒiij.; pigs, ʒj. to ʒij.; dogs, grs. xx. to grs. lx. The maximum doses are stimulant and antispasmodic, the minimum, frequently repeated, are diuretic and inspissant. They are administered with milk, oils, linseed gruel, mucilage, eggs, or about 1-20th part of magnesia. For external purposes they are made into liniments and ointments.

II. OIL OF TURPENTINE. Oleum Terebinthinæ.

The crude turpentines when heated, as they usually are by steam, yield 15 to 25 per cent. of oil of turpentine, sometimes improperly called spirits of turpentine. It is **a mixture of several hydrocarbons,** having the composition $C_{10}H_{16}$. It is limpid, with a strong peculiar odour and a pungent bitter taste. It commences to boil at about 320° F. According to its source it varies in its odour, specific gravity, boiling point, and effect on polarised light. It is very inflammable, burning with a heavy yellow flame and producing much smoke. It is very sparingly soluble in water, more soluble in alcohol, and readily dissolved in ethers, fixed and volatile oils. It is a valuable solvent for resins, fats, many alkaloids, india-rubber, and gutta-percha.

It is **the representative of a large group of terpenes,** including the volatile oils of chamomile, caraway, juniper, lemons, pepper, savin, thyme, tolu, and valerian—all of which have the formula $C_{10}H_{16}$. In common with other terpenes, it is convertible into isomerides, oxidises on exposure to air, forming camphoric peroxide (p. 561); with water produces crystalline hydrates; and with hydrochloric acid forms crystal-

line compounds. By this action of hydrochloric acid on turpentine artificial camphor is produced. **Terebene** is obtained by the oxidation of turpentine by sulphuric acid; it is isomeric with oil of turpentine, and distinguished from it by being less disagreeable and acrid to the taste, and optically inactive. Its medicinal properties are the same as those of turpentine.

ACTIONS AND USES.—Oil of turpentine is an antiseptic and topical irritant. Large doses are irritant and narcotic. Medicinal doses are antiseptics, stimulants especially of mucous and skin surfaces, antispasmodics, hæmostatics, and anthelmintics. It is also prescribed as an adjuvant cathartic, diaphoretic, and diuretic. It is applied externally as a rubefacient, vesicant, and parasiticide.

GENERAL ACTIONS.—Like other volatile oils, it is an active **antiseptic.** In destroying bacteria spores, Koch found it much more effective than alcohol, ether, chloroform, or benzol. No spores germinated after being wetted with it for five days. It **poisons lice acari** and other entozoa, whether lodged in the skin, bronchial tubes, or bowels. Applied to the skin it irritates, and if evaporation be prevented, vesicates, and even ulcerates.

When swallowed it is **rapidly absorbed,** diffused, and excreted, and may be speedily detected in the chyle, breath, and perspiration, which acquire a strong terebinthinate flavour, and in the urine, to which it imparts the odour of violets. It **first stimulates and then paralyses vaso-motor centres.** As with alcohol, the paralysis is quickly produced by large doses. According to the dosage and stage of action it hence produces a rise or fall of blood-pressure, quickening or slowing of the pulse, rise or fall of temperature; but respiration throughout is generally quickened. It is **eliminated** by the lungs acting as a stimulating expectorant, by the skin promoting diaphoresis, by the kidneys inducing diuresis, while full doses, especially in combination with laxatives, are cathartic.

TOXIC EFFECTS.—Large doses when inhaled irritate the respiratory mucous membrane, and reflexly cause difficult breathing. Large doses when swallowed cause gastro-enteritis, and occasionally ulceration of the bowels. A large dose quickly swallowed, as in the case of alcohol, produces brief primary stimulation and prolonged subsequent paralysis.

Rabbits and kittens were paralysed by injection of turpentine emulsion into the stomach. The motor centres are implicated in the same order as in poisoning with members of the alcohol series, those of the brain being first affected, those of the cord later, and those of the medulla last (p. 189). A dog into whose veins two drachms were injected staggered, was convulsed, circulation and respiration failed, and death occurred in three minutes (*Christison On Poisons*). During excretion large doses cause congestion and irritation of the urinary organs, diminish or arrest secretion of urine, and induce strangury and sometimes hæmaturia.

MEDICINAL USES.—In indigestion, flatulence, and atonic diarrhœa, it checks undue fermentation and acts as a **carminative** and gastro-intestinal **stimulant** and **astringent.** Although an uncertain cathartic when given alone, like many other volatile oils, it promotes the action of cathartics, with which it is usefully conjoined in flatulent colic, and in such cases it is also used in enemata. Alike in flatulent and spasmodic colic in horses, it is frequently given combined either with linseed oil or with mucilage and aloes, and in spasmodic cases is conjoined with opium.

As a **cardiac and general stimulant** it is not so effective as alcohol or ether. But stimulating vaso-motor centres and contracting arterioles it **checks** unhealthy or excessive **mucous discharges,** as in chronic bronchitis and nasal gleet. In such cases terebene gargles and turpentine emulsions and inhalations prove useful, sometimes seconded by turpentine liniments applied externally. The **astringent hæmostatic** effects are more remotely distributed in purpura, scarlatina, and in passive hæmorrhages from the lungs, stomach, and bowels, as well as from the kidneys, although in renal cases the drug must be used cautiously and in small doses. In **purpura** in horses, ounce doses are prescribed, with the same quantity of iron chloride tincture, twice or thrice daily. This prescription, with two drachms potassium chlorate, sometimes benefits farcy subjects, and is useful in many cases of hæmoglobinuria. Chronic rheumatism in all classes of patients is frequently relieved by conjoining turpentine with salines, and is also usefully applied externally.

Turpentine well kept and fully oxidised, as the French variety generally is, proves an **antidote for poisoning with phosphorus.** Diffused in the atmosphere of rooms in which phosphorus is prepared for lucifer matches or other purposes, it diminishes the prevalence of necrosis of the jaw and other serious disorders which affect persons working with the ordinary phosphorus (*Dr Letheby*). Phosphorus in repeated doses produced in animals fatty degenerations; but neither this nor other forms of phosphorus poisoning occurred when the drug was given with French turpentine (*Köhler*). Personne gave phosphorus to five dogs, and all died. To five others, an hour or two after similar lethal doses, he gave turpentine, and only one died. Of five dogs to which he gave turpentine immediately after deadly doses of phosphorus, only one died (*Dr Ringer's Handbook of Therapeutics*).

In cattle practice full doses are valuable in hoven. Chronic **diarrhœa** and **dysentery,** especially when accompanied by flatulence, are usually benefited by small doses conjoined with lime-water, aromatics, or opium. When contagious pleuro-pneumonia was subjected to curative treatment, two ounces were sometimes prescribed several times daily. In **puerperal apoplexy** it is given with ammonia carbonate; in **puerperal peritonitis** with laudanum, and in such cases it is also applied as an external stimulant. Mr A. G. Macgillivray, Banff, in **post-partum hæmorrhage** in cows, gives three to five ounces with six eggs and ginger (*Veterinary Journal*, June 1888). Frequently repeated doses, conjoined with iron salts, check that form of hæmaturia in cattle popularly known as **red-water.**

For the **destruction of intestinal worms,** oil of turpentine is generally conjoined with a laxative, and given after the bowels have been emptied by a cathartic, and the patient has been fasted. Although it removes lumbrici and stronguli, it is not in horses a very certain remedy for tapeworms, but its efficacy is increased by combination with male shield fern. A tolerably good tænicide for the horse consists of two ounces of turpentine and one ounce of male shield fern extract, dissolved in a pint of linseed oil. For tapeworms in dogs, areca nut and santonin are more effectual and safe than turpentine.

For destroying the strongulus micrurus infesting the air-passages of calves and lambs, turpentine has been widely used. In some sheep-breeding districts of England, thriftless coughing lambs throughout the summer months, at intervals of a week or ten days, have terebinthinate drenches, given with the view of preventing and curing both thread and tapeworms; and such treatment certainly greatly diminishes the scouring and mortality to which lambs in some localities are liable. Six-months' calves take half an ounce, lambs of the like age a drachm, of oil of turpentine, conveniently mixed with milk and administered by the mouth. Two or three doses, at intervals of two or three days, usually effect a cure. Some stock-owners senselessly pour the irritant draught into the nostrils, running much risk of choking the patient. Turpentine inhalations, although fairly effectual, are troublesome to manage. For calves **intra-tracheal injection** of turpentine has recently been successfully introduced by Mr J. Hutton, F.R.C.V.S., Kelso, who makes a small incision with a knife through the skin, half-way down the neck and between the rings of the trachea, and with a suitable syringe—which any instrument-maker can furnish—injects f℥i. to f℥ij. oil of turpentine, with f℥ss. each of carbolic acid, chloroform, and glycerin, which ensures solution of the carbolic. No serious irritation results. A few paroxysms of coughing occasionally occur. Brought into actual contact with the parasites, the vermicide promptly destroys them (*Veterinarian* for January 1885).

Gapes in poultry, caused by the Sclerostoma syngamus, is generally treated by a similar solution, used diluted with 4 or 5 parts of milk or bland oil, two or three drops of the mixture being placed in the mouth of the ailing fowl. A similar dressing is sometimes applied around the throat, but, although in part absorbed, is not so effectual as when swallowed.

Externally, oil of turpentine is used as an antiseptic, stimulant, and counter-irritant. Applied undiluted to the skin of horses, it quickly causes topical irritation and restlessness, and if used largely and repeatedly, it is besides apt to blemish. Cattle are not so sensitive to its irritant effect, and for them it is sometimes employed to increase the activity of other vesicants, and control inflammation of the air-passages, bowels,

and joints. A piece of flannel wrung out of hot water, and sprinkled with turpentine oil, is frequently applied as a **counter-irritant.** A continuous moderate action is more serviceable than a single violent effect. For inveterate eczema and psoriasis after removal of the scales with soft soap and water or alkaline dressings, turpentine diluted with 1 or 2 parts of bland oil or glycerin and water, sometimes beneficially stimulates the hypertrophied weakened skin, and promotes cure. Similar results are effected in some persistent cases of ringworm.

It is chiefly used as a **stimulant** for rheumatic swellings, more particularly of cattle and sheep; for sprains and bruises after the first pain and tenderness have been subdued by fomentation; for controlling congestion arising from frost-bite, which is not uncommon in the limbs of horses used for night-work; for promoting absorption of sitfasts; for healing the troublesome chronic abscesses occurring about the heels of heavy draught horses; for arresting dry gangrene of dogs' ears; aud for relieving tedious foot-rot in sheep. For such cases it is usually mixed with 2 or 3 parts of vaselin, bland oil, or glycerin. A similar mixture destroys lice and other skin vermin. An occasional sprinkling over dogs' beds keeps them free of fleas. It is often added to stavesacre, tobacco, and other antiparasitic dressings. It enters into the composition of various mixtures used by shepherds to protect their flocks from fly and to kill maggots. For such purposes three ounces oil of turpentine, one ounce each of oil of amber and mucilage, and one drachm corrosive sublimate, are mixed in a quart of water.

DOSES, ETC.—For horses and cattle, as a stimulant and antispasmodic, the dose is f℥j. to f℥ij.; as a diuretic, f℥ss. to f℥j. As an adjuvant cathartic or anthelmintic, the dose is about f℥ij., combined with aloes in solution, with castor or linseed oils, with iron salts, quassia, gentian, or other bitters. Big adult cattle, with impunity, take double these doses. Sheep and pigs receive fʒj. to fʒiv.; dogs, ♏xx. to fʒj. It is administered dissolved in bland oils; shaken up with linseed gruel or milk, or made into an emulsion with mucilage or eggs. Aromatics, bitters, or ethers are sometimes added.

For **inhalation,** half a bucket of boiling water is placed under the patient's nostrils, and an ounce of turpentine placed in it; or, better still, it may be introduced into the steam-kettle, which is as serviceable in the treatment of bronchitis in animals as in man. For **enemata,** turpentine is usually diluted with 15 or 20 parts of mild oil; or it is mixed with 2 or 3 parts of oil or mucilage to ensure solution, and the requisite proportion of soap and water is then added. In diarrhœa or dysentery, it is conjoined with laudanum and starch gruel.

For **external purposes** it is usually applied with linseed oil, soft soap, or ammonia liniment. A convenient **stimulant dressing** is made with equal quantities of oil of turpentine, bland oil, and soft soap. Two or three ounces of oil of turpentine, added to a pint of soap liniment, also make a useful embrocation. As a stimulant for rheumatism, 1 part each of oil of turpentine and laudanum is mixed with 2 or 3 of linseed oil or soft soap. For dogs, a prompt blister is prepared with an ounce each of oil of turpentine and medicinal ammonia, and six to ten ounces of any bland oil.

Oil of Scotch Fir, Oleum pini sylvestris, is prepared by distilling the fresh leaves of the Scotch fir or pinus sylvestris. It has most of the properties, and is applied to many of the uses of oil of turpentine.

Terebene (p. 616) being less acrid than oil of turpentine, and less liable to act on the kidneys, is sometimes substituted for it, especially as a stimulant and antiseptic in excessive mucous discharges, and for relieving flatulence. Externally, it is applied as a stimulant, antiseptic, and deodoriser for many of the purposes for which carbolic acid is used.

III. Resin, Rosin, Resina.

The crude turpentines contain 75 to 90 per cent. of **resin** or **colophony,** developed by a process of oxidation. Crude turpentine, when distilled with a little water, which the resin retains, leaves a residue of yellow or white resin. When the water is removed, the resin becomes transparent, and when more strongly heated, is still clearer, and is known as black or

fiddler's resin. These turpentine resins are the type of a considerable group of resins derived chiefly from the vegetable kingdom, distinguished by their appearance, fusibility, inflammability, acidity to test-paper; burning with a smoky flame; insoluble in water, and soluble in alcohol, volatile oils, and alkalies. They unite with fats, wax, and spermaceti, and are largely used in the manufacture of yellow soap. Resin has the formula $C_{44} H_{62} O_4$. Coarsely powdered, and shaken with warm dilute alcohol, it undergoes hydration, and yields 80 to 90 per cent. of abietic or silvic acid, $C_{44} H_{64} O_5$. **Bordeaux resin** or gallipot contains, besides the isomeric, pimaric acid.

ACTIONS AND USES.—Resin is a gentle stimulant, astringent, and diuretic. Two to four ounces, swallowed by horses or cattle, cause diuresis. It is added to diuretic masses to increase their consistence. Externally, it is used as a stimulant, astringent, and styptic. In castration, a few grains applied to the severed end of the spermatic cord, when melted by contact of the hot iron, help to seal bleeding vessels. It is largely used to impart firmness and adhesiveness to stimulant plasters. The simple **digestive ointment** is made with equal weights of resin, yellow wax, lard, and almond oil, melted with gentle heat, strained while hot through flannel, and stirred constantly while it cools. This simple ointment is much used as a lubricant and mild stimulant for wounds, ulcers, blistered surfaces, and for giving bulk and consistence to other ointments.

IV. TAR, OIL OF TAR, AND PITCH.

Tar, or Pix liquida, is a thick, viscid, brownish-black, aromatic liquid, obtained from the wood of Pinus sylvestris and other pines by destructive distillation. Mineral or Barbadoes tar has already been noticed (p. 525). Coal tar, obtained from the destructive distillation of coal, is a by-product in the manufacture of gas. Two descriptions of wood-tar are in use —(1) that got from such hard exogens as oak, birch, and ash, as a residual product in the making of charcoal for gunpowder; and (2) that more empyreumatic variety imported from Stockholm, Archangel, and America, got by roasting

billets of the roots, branches, and refuse coniferous timber stacked in shallow pits dug on a bank or inclined plane. The heaps are closely covered with turf; fire is applied; smothered combustion proceeds; tar runs into iron pots placed at the bottom of the pit, and thence by spouts into the barrels in which it is exported. This old process is being superseded by distillation of the refuse wood in cast-iron stills, whereby nearly double the yield of tar is obtained; 14 per cent. is got from air-dried stems, 16 to 20 per cent. from roots. When wood is thus distilled the condensed products separate into two layers, the upper a mixture of methyl-alcohol, pyroligneous, acid, acetone, &c., in water (p. 186); the lower wood-tar.

Tar is soluble in ether, oils, and alkaline solutions, but not in water, which, agitated with it, acquires, however, its odour, taste, and brown colour, and constitutes **tar water,** once regarded a valuable medicine. Tar is a complex substance consisting of pyroligneous acid, methyl-alcohol, various oily bodies, and creasote with toluene, xylene, and other hydrocarbons.

Tar when distilled yields **oil of tar,** oleum picis liquidæ—an empyreumatic acid liquid, which, although colourless when first distilled, speedily becomes yellow or brown, and is soluble in alcohol. It contains the more volatile hydrocarbons of the tar. There remains in the retorts **pitch,** or pix nigra, a black, bituminous substance, solid and brittle, with a shining fracture, dissolved by the same solvents as tar, and consisting of modified resin, and a colourless, inodorous crystalline substance, melting at 194° F., called retine (C_{18}, H_{18}) (*Flückiger*).

Actions and Uses.—Tar is antiseptic, stimulant, diuretic, diaphoretic, expectorant, and parasiticide. Its **antiseptic** effects are exhibited by the urine of horses getting tar water, keeping unchanged for several days. It is still occasionally prescribed for horses in chronic cough and bronchitis, where the discharges are copious. It is used both internally and externally as **a cutaneous stimulant and antiseptic** in the squamous stages of grease and other forms of eczema, in psoriasis, and in pityriasis, the scaly surfaces being coated daily wlth undiluted tar, the dressing after several days washed off with soft soap and water, and any refractory spots

dressed with mercurial ointment. In chronic eczema one part of tar is usefully added to four of zinc oxide ointment. Tar water is a popular but serviceable lotion for indolent ulcerations and hæmorrhoids. For thrush and canker of the horse's foot tar is used either alone or with copper sulphate, sulphuric or nitric acid.

Mixed with equal parts of fatty matters, soft soap, or cow-dung, in order to give proper consistence, it forms an excellent **stopping for horses' feet**, keeping the hoof moist and soft, and stimulating secretion of horn. For maintaining the horn in a tough, elastic, and healthy state, Mr Miles, in his useful pamphlet on the "Foot of the Horse," recommends a quarter of a pound each of tar, bees' wax, and honey, a pound and a half lard, and three ounces glycerin: the lard and bees' wax are melted together, the lard, tar, and glycerin stirred in, and stirring continued until the mass begins to set. In **foot-rot in sheep,** tar has the several advantages of stimulating and deodorising unsound noisome textures, and preventing attacks of flies. It is used for securing wounds, binding up broken horns, and making adhesive plasters.

Oil of tar is sometimes used instead of oil of turpentine. Its empyreumatic constituents confer antiseptic properties: it cures mange and scab, destroys other parasites, is sometimes added to sheep dips, but has the disadvantage of discolouring the wool, does not mix well with the other ingredients, while large doses or strong solutions are apt to become absorbed and cause pulmonary congestion. It is applied for both favus and tinea tonsurans, but is seldom so successful as iodine.

Pitch is used as a mild stimulant in thrush, canker, and sandcrack in horses; in foot-rot in sheep; for giving adhesiveness to plasters; while as a domestic air-purifier its empyreumatic fumes are occasionally disengaged by inserting a red-hot poker into an iron pot containing pitch.

VALERIAN.

VALERIANÆ RADIX. The dried rhizome and rootlets of Valeriana officinalis. Collected in autumn from plants growing wild or cultivated in Britain. (B. P.) *Nat. Ord.*—Valerianaceæ.

The officinal valerian consists of a short yellow-brown tuberous rhizome about the thickness of the little finger, with attached radicles two or three inches in length, shrivelled, brittle, and of an earthy-brown colour. It has a penetrating odour, which becomes strong and even fœtid by keeping, and a camphorous, unpleasant, rather bitter taste. It contains 1 to 2 per cent. of a strong-smelling active **volatile oil,** isomeric with oil of turpentine ($C_{10}H_{16}$), and the oily acrid **valerianic acid** (C_4H_9. CO_2H), which is also present in the berries of the guelder rose, in whale oil, and decaying cheese, and may be obtained artificially by distilling amyl alcohol with sulphuric acid and potassium dichromate, and treating the distillate with caustic alkali.

ACTIONS AND USES.—Valerian and its volatile oil in large doses paralyse the brain and spinal cord, lower blood-pressure, and slow the pulse. They are topical irritants, stimulants, and antispasmodics. Valerianic acid has no special stimulant action, but is said to resemble acetic acid (*Royle*). The valerianates accordingly do not exhibit the action of valerian or of the volatile oil.

MEDICINAL USES.—Valerian resembles asafœtida, the other gum resins, camphor, and the sumbul or musk-root imported from Russia and India, and produced by an umbelliferous plant. It has little effect on horses or cattle, even in doses of several ounces. It is occasionally given to dogs to allay nervous irritability, and relieve chorea and epilepsy; but little dependence can be placed on it. It attracts and excites cats, developing their amatory propensities by its suggestive odour. The volatile oil abates the convulsions of strychnine poisoning, is an anthelmintic, and is excreted by the lungs, skin, and kidneys.

DOSES, ETC.—Used for horses or cattle, valerian may be

given in quantities of ℥ij. to ℥iv.; for dogs, ʒj. to ʒij.; for cats, grs. xx. to grs. lx., given in powder or infusion several times a day; conjoined with ginger, gentian, or camphor, or dissolved in spirit of ammonia.

THE VALERIANATES, as above indicated, exhibit the actions of their bases, but not those of valerian. Where it is desired to conjoin the physiological action of valerian with iron, zinc, or other metallic salts, or with quinine, the oil of valerian should be prescribed with a suitable salt of the metallic or vegetable base. The valerianates have been used for dogs and cats in epilepsy, chorea, and nervous excitability, in doses of grs. ij. to grs. v.

Sodium Valerianate, or Sodæ Valerianas ($Na\ C_5\ H_9\ O_2$), is obtained by the oxidation of fusel oil, by distilling it with potassium dichromate and sulphuric acid, and saturating the distilled liquid with solution of soda. It occurs in dry white masses devoid of alkaline reaction, is soluble in rectified spirit, and emits a strong odour of valerian when moistened with dilute sulphuric acid.

Ferric Valerianate is made by mixing, in the cold, solutions of sodium valerianate and iron sulphate. The precipitated ferric valerianate dries as a loose, light-red powder, with a faint odour of the acid, and a styptic taste.

Zinc Valerianate is prepared by dissolving and heating together sodium valerianate and zinc sulphate. On evaporation the zinc valerianate crystallises in white, pearly, tabular crystals, with a feeble odour of valerian and a metallic taste.

Quinine Valerianate, prepared by mutual decomposition of sodium valerianate and quinine sulphate, occurs in silky, needle-like crystals, which have a bitter taste of quinine and a slight odour of valerian, and are dissolved with difficulty in water, but readily in rectified spirit and ether.

VERATRINE.

VERATRIA. An alkaloid or mixture of alkaloids obtained from Cevadilla; not quite pure. (B. P.)

It is prepared from the concentrated tincture of the dried ripe seeds of cevadilla or sabadilla—the Asagræa officinalis—

a Mexican liliaceous plant. It is pale grey, amorphous, odourless, bitter and acrid, insoluble in water, but soluble in spirit, in ether, and in diluted acids. It dissolves in nitric acid, yielding a yellow solution, and warmed with hydrochloric acid it dissolves with production of a blood-red colour. It consists of the active alkaloid veratrine ($C_{37}H_{53}NO_{11}$), and of traces of two other alkaloids which are believed to have little activity.

ACTIONS AND USES.—Veratrine is a topical irritant and subsequent paralysant, a muscle and cardiac paralysant, and is sometimes applied externally to relieve rheumatic and neuralgic pains, and as an antiparasitic and vermin killer.

GENERAL ACTIONS.—Rubbed into the skin or placed upon a mucous surface, it causes irritation and then numbness, similar to that produced by aconite, and depending upon irritation followed by paralysis of sensory nerve-endings. When inhaled it induces violent sneezing; when swallowed in considerable doses it causes gastro-enteritis followed by collapse. It produces prolonged muscular contraction. Muscles which have been exhausted by over exertion have their powers restored by veratrine. The effect on the heart muscle is the same as on voluntary muscles. Motor, like sensory nerves, have their sensibility increased, but subsequently their peripheral ends are paralysed. It has no marked action on the brain or spinal cord. Its actions closely resemble those of Veratrum viridi and V. album.

TOXIC EFFECTS.—Magendie found that one grain of veratrine acetate killed a dog in a few seconds when injected into the jugular vein, and in nine minutes when injected into the peritoneum. One to two grains swallowed by dogs caused great uneasiness, nausea, vomiting, violent purging, slowness of respiration, slowness and irregularity of circulation, extreme prostration of strength, spasmodic twitching, and subsequently paralysis of the voluntary muscles, especially those of the extremities, and death, usually amid convulsions. The appropriate **antidotes** are stimulants, warm coffee, potash solution, and perfect quiet.

MEDICINAL USES.—From its notably lowering heart action and temperature, it has been prescribed in acute febrile diseases, such as pleurisy, peritonitis, rheumatism and laminitis, but it

is apt to be violent and uncertain in its effects. Externally a solution or ointment is used to relieve rheumatic and neuralgic pains, and as an insecticide.

VERATRUM VIRIDI AND ALBUM.

VERATRI VIRIDIS RHIZOMA. Green Hellebore Rhizome. The dried rhizome and rootlets of Veratrum viride. (B. P.)

VERATRI ALBI RHIZOMA. White Hellebore Rhizome. Dried rhizome and rootlets of Veratrum album. Not officinal. *Nat. Ord.*—Colchicaceæ or Melanthaceæ.

The Veratrum viridi is a native of North America, the V. album is indigenous in many parts of continental Europe. Both are perennial liliaceous plants, producing tuberous fleshy root stalks, which, with the attached rootlets have a bitter acrid taste, excoriate the mouth and fauces when chewed, and produce sneezing when the powder is inhaled. They contain several alkaloids—jervine ($C_{26}H_{37}NO_3$), pseudo-jervine, cevadine, and traces of veratrine.

ACTIONS AND USES.—Both the veride and album are **motor depressants,** closely allied in physiological action to veratrine, and resembling aconite and tobacco. They slow and weaken the action of the heart, and cause muscular weakness, nausea, and in men and dogs vomiting. Fuller doses induce extreme rapidity, weakness and imperceptibility of the pulse, partial unconciousness, and collapse. The album is more powerful than the viride.

Professor H. C. Wood states that **jervine** depresses the functions of the spinal cord and cardiac ganglia, producing muscular and cardiac weakness, while concurrently it irritates the motor centres of the brain, inducing convulsions. Death ensues from paralysis of respiration (U. S. A. *Dispensatory*).

TOXIC EFFECTS.—Waldinger states that two ounces veratrum album caused in **horses** increased salivation, efforts to vomit, and relaxed bowels. Rytz declares that one ounce induces purgation and gastric derangement. Mr Miller, Bradnoch, in the *Edinburgh Veterinary Review* for 1863, records that a three-year-old filly accidentally ate about two ounces of the powdered

root, and in half an hour was in much pain, frothing at mouth, attempting to vomit, heaving at the flanks, with a full pulse, numbering forty; painful spasms, involving especially the muscles of the neck, injection of the mucous membranes of the nostrils and eyes, stiffness in walking, and, after a few hours, partial paralysis of the hind limbs. The filly was bled, and had drachm doses of tannin given in starch gruel. In three hours the symptoms abated, gradual recovery took place, and in four days she was again at work.

Dogs are liable to suffer from absorption of strong dressings. Mr Howard records that liberal application of veratrum ointment causes nausea, sometimes vomiting, accelerated and weakened action of the heart, short, catching, and moaning respiration, prostration, with death sometimes in four hours. Congestion of the mucous membrane of the stomach, lungs, and heart, was notable post-mortem (*Veterinarian*, February 1873). The **antidotes** consist in demulcents, diffusible stimulants to counteract cardiac depression, and morphine to relieve nausea and gastric irritation. Infusions of tannin form insoluble compounds with unabsorbed alkaloids.

Medicinal Uses.—Mr Morton considered that veratrum "powerfully rouses the absorbent system," and recommended it for chronic œdema of the legs. As a sedative in acute inflammatory diseases it was highly spoken of by Percivall and Morton, who prescribed it for horses in doses of 20 to 30 grains, repeated every four or five hours. But its actions are irregular and uncertain. For neuralgic and rheumatic cases it has been superseded by aconite. For the destruction of lice, for smearing setons, and as an addition to blisters—objects for which it is still occasionally used—there are more fitting remedies. Active preparations have the disadvantage of sometimes being absorbed and producing untoward constitutional effects.

Doses, etc.—Of the powdered rhizome horses and cattle take ʒss. to ʒj.; sheep and pigs, grs. xx. to grs. xxx.; dogs, grs. ij. to grs. vj.: given in bolus, or dissolved in dilute alcohol, and repeated at intervals of three or four hours. It is used **externally** in the several forms of powder, watery decoction improved by a little spirit, and ointment made with 1 part of

veratrum to 8 of vaselin or lard. It is occasionally applied with tar or sulphur dressings.

WATER.

AQUA. Hydrogen oxide or Monoxide (H_2O).

Two volumes of hydrogen and one of oxygen, in the presence of a light or an electric spark, unite with explosive force, yielding two volumes of gaseous water or steam. It exists in the solid, liquid, and gaseous forms. The familiar liquid is transparent, neutral, colourless, odourless, and tasteless. A minim weighs ·91 grain; a fluid ounce, 437·5 grains. It is the standard of comparison for specific gravities of liquids; its specific gravity being represented as 1 or 1000. It solidifies, freezes, or crystallises at 32° F., expanding and giving out latent heat; it reaches its greatest density at 39°·2 F.; it slowly volatilises at all temperatures; at 212° F. it boils, rising in steam or gas, and increasing in bulk 1700 times. A cubic inch of water becomes a cubic foot of steam. When the solid ice melts, heat is absorbed or becomes latent; when the liquid water boils, or gives off gas, still more heat is absorbed. A cubic foot of water expanding into steam renders latent 1000° F. of heat. The melting ice or evaporating water, thus abstracting heat from bodies in contact with them, are valuable refrigerants.

Water is a very **universal solvent**; it readily dissolves many mineral matters, gases, and organic substances. From soils and rocks through which it passes, it takes up **salts,** especially of calcium, magnesium, and sodium, and occasionally of lead (p. 442). It absorbs atmospheric air, carbonic acid, and other **gases,** some adding to its sparkling, refreshing, and palatable qualities, others rendering it disagreeable and unwholesome. Gases are more soluble in cold than in hot water; solids conversely are generally more quickly and freely dissolved by hot than by cold water. **Organic matters** are present, especially in river and marsh waters, causing them to spoil rapidly when kept, and to produce diarrhœa and dysentery in animals drinking them. Surface drainage and sewage are

apt to introduce vegetable and animal **parasites** and their ova, which give rise to dangerous diseases in animals as well as in man.

Even in potable waters, the nature and proportion of **the solid constituents** differ materially. Glasgow derives from Loch Katrine the purest water supply of any large city in the world, containing only $\frac{3}{4}$ of a grain of organic matter and $1\frac{1}{2}$ grains of inorganic matters to the gallon. The water of the Thames, supplied to part of London, contains about 3 grains of organic and 16 grains of inorganic matters to the gallon. When the mineral constituents, consisting of salts of calcium and magnesium, exceed $\frac{1}{5000}$th part, the water is said to be hard, and is unsuitable for many pharmaceutic and domestic purposes; it curdles or precipitates soap, instead of forming with it a froth or lather; it forms a brown encrustation on the kettles or furnaces in which it is boiled; it is not so well liked by animals, and is apt to cause diarrhœa and other digestive derangements, especially in subjects unaccustomed to it. When the salts do not amount to $\frac{1}{5000}$th part, the water is considered soft.

The presence of the more dangerous **organic and organised impurities are discovered** by several simple tests—(1) Half a pint of the water is well shaken in a clean wide-mouthed bottle; when sewage is present, an offensive smell will be perceived on removal of the stopper or cork. (2) In a tumbler of water two or three drops of sulphuric acid are placed, and sufficient Condy's red fluid to render the water pink. When allowed to stand for fifteen minutes, the water, if containing organic impurity, will have become colourless. (3) Common salt, usually abundant in water contaminated with sewage, may thus be discovered: A few drops of silver nitrate, poured into a carefully cleaned glass, should not have its transparency impaired, but the addition of a little water containing salt produces milkiness ($Ag\ Cl$), which is not removed by a few drops of nitric acid.

For purifying water various methods are adopted. **Subsidence** and decantation get rid of grosser mechanical particles. **Filtration** through sand, charcoal, gravel, or spongy iron removes coarse organic impurities. **Alum,** even in minute

amount, clears turbid water. **Oxidation** gradually destroys disagreeable or dangerous defilements ; hence a running stream contaminated even by sewage, a few hundred yards lower down may again become clear and wholesome. **Alkaline permanganates,** by similar oxidation, promptly destroy organic contamination. **Boiling** destroys most noxious vegetable and animal matters, drives off carbonic acid gas, and thus throws down calcium carbonate, the cause of **temporary hardness.** **Sodium carbonate,** or **lime,** as in Clarke's process, diffused through hard water, which is then allowed to settle, abstracts carbonic acid gas, and causes subsidence of calcium and magnesium carbonates, and also reduces the more **permanent hardness** produced by calcium sulphate. For delicate chemical and pharmaceutical purposes, **aqua distillata** is requisite, and distillation leaves behind all impurities except a trace of organic matters, and 1 to 2 per cent. per volume of air. Such distilled or other pure water is understood to be used when " water " is ordered for pharmaceutic purposes.

Mineral waters are unfit for general use on account of their undue proportion of mineral matters, or gases, or from their being at a higher temperature than that of the locality in which they are found. The most common mineral waters are those containing iron and salines. **Sea water** has a specific gravity of 1027 ; an imperial pint contains about 312 grains of solid matters, of which about 240 grains are common salt.

Actions and Uses.—Water is nutrient, diluent, antipyretic, evacuant, and detergent. Introduced into the body in excess of its requirements, it is removed usually within six hours, chiefly by the kidneys, but also by the skin and bowels. When given cold, the kidneys perform the main excretory office ; but when used hot, water is an adjuvant diaphoretic, cathartic, and, in dogs and other carnivora, an emetic. Water applied topically, as in the form of hot fomentation, or as the familiar water dressing, is emollient and anodyne, abates congestion of circumscribed inflammation and wounds, and its beneficial effects are also reflexly propagated to adjacent parts. At high temperatures water is an irritant. But steam mixed with air is emollient and soothing. Cold water is refrigerant and tonic. Ice is a prompt and effective refrigerant ; it

controls congestion and inflammation, especially of the throat, and arrests hæmorrhage from the stomach, lungs, and other parts. Baths are used not only for comfort and cleanliness, but for the cure of disease, and have already been discussed (p. 132).

Water constitutes from 55 to 60 per cent. of the weight of the higher animals, and is essential for digestion, absorption, secretion, excretion, and indeed for every vital process. It is largely present **in every kind of food,** facilitating its digestion and assimilation, and replacing the loss of fluid constantly taking place by the skin, lungs, and kidneys. Insufficient and excessive supplies are alike injurious ; but animals in health, and with constant free access to water, rarely take more than is good for them. Excepting for a few hours previous to any great exertion, and when hungry, overheated, and prostrated, the horse in health should not be restricted in his water supply. Indeed, in many well-managed modern stables, a limited amount of water is constantly at the horse's head ; and under such circumstances the daily quantity drunk is actually less than when the animal is allowed to slake his thirst three or four times daily. Although a moderate amount of water is essential for digestion, an excessive quantity injuriously dilutes the alimentary ferments, and favours acid fermentation. In animals very thirsty and long deprived of water, drinking too freely may cause destruction of blood-corpuscles by osmosis (*Ringer*).

Horses, especially if tired and hungry, before having a little hay—which, being slowly eaten, is in such circumstances preferable to grain—should receive a few swallows of water, or, better still, a gallon of gruel. In some cab and carrying establishments, each hard-worked horse, on his return to the stable, is provided with a supply of oatmeal gruel, which is found not only to help condition, but to diminish attacks of colic and other gastro-intestinal derangements. A copious draught of water, taken immediately after a rapidly-eaten meal, hurries the imperfectly digested food too rapidly into the large intestines, where it is very apt to set up colic and inflammation. **Very cold water** freely drunk, especially by hungry exhausted horses, is a fruitful cause of gastro-intestinal

derangement; and in many establishments, throughout winter, steam or hot water is introduced into the horse-troughs, or the buckets are filled and brought into the stable several hours before they are required for use.

Water judiciously used is a valuable **diluent, febrifuge,** and **evacuant,** serviceable in febrile and inflammatory diseases. It is more palatable and satisfying when given moderately cold, rather in the tepid state in which it is sometimes presented to sick horses. Thirst is frequently more effectually quenched when water is rendered feebly bitter with a little cascarilla or quassia infusion—additions which favour secretion of the alkaline saliva. Small portions of ice, placed in the mouth, are sucked by most animals, and not only abate thirst, but control irritation and promote secretion. Horses disposed to be greedy of water, and especially those with damaged wind or liability to acidity or diarrhœa, should be supplied with small quantities and often, whilst further to relieve thirst the food should be damped. After a cathartic dose, and until the physic has ceased to operate, even moderate draughts of cold water in many horses cause griping. Calves and lambs, feverish and purging, soon kill themselves if they have free access to water.

As a **diluent,** water mechanically relieves choking and coughing; dilutes corrosive and irritant poisons; assists the action of diaphoretics, diuretics, and purgatives. Tepid water is a convenient **auxiliary emetic** for dogs and pigs. Injected into the rectum, warm water allays irritability of the bowels and urino-genital organs, and promotes the action of the bowels. Injection of cold water checks bleeding, produces general reaction, and occasionally expels ascarides. Injected into the vagina, it stays discharge of blood or of leucorrhœa. A good scrubbing with tepid water and soap is a very essential preliminary to the successful treatment of mange or scab. It removes scales and dirt, abounding especially in inveterate cases, and hence facilitates access of the special dressings to the burrows of the female parasite.

Water is the important constituent of most **emollients** (p. 72). **Hot fomentations** (p. 142) moisten, soften, and relax dry and irritable textures, and relieve tension, tenderness, and

pain. Applied early, and continued for several hours, they control or prevent congestion or inflammation of strains, and severely contused wounds. Their external application, by reflex action, often soothes irritated or inflamed internal parts. In this way fomentations allay the pain of colic and inflammation of the bowels. Steaming of the head and throat, in like manner, often relieves catarrh, sore throat, and strangles. Professor Williams insists on the value both of steaming and hot fomentations in laryngitis, croup, and bronchitis, and prefers fomentations to counter-irritants in pneumonia and pleurisy (*Principles and Practice of Veterinary Medicine*).

Soothing watery vapour, medicated, if need be, with laudanum, belladonna, ether, vinegar, sulphurous acid, or alkaline hypochlorites, is readily evolved from a steam-kettle, from a well-made bran mash, placed in a roomy nose-bag, or from a bucket of water, from which steam is driven off by plunging a hot iron into it at short intervals.

Water-dressings, consisting of several folds of lint or tow, saturated with hot water, and covered with oiled skin, macintosh or gutta-percha cloth to retard evaporation, or a sheet of well-soaked spongio-piline, are frequently substituted for fomentations and poultices, and are usually preferable, especially to poultices, on account of their lightness, cleanliness, and less tendency to sodden and injure adjacent parts.

Water nearly boiling is a prompt and powerful **counter-irritant,** especially useful in cattle practice. It is laved over the part either with a sponge or piece of flannel or soft rug. When applied to the chest or abdomen of horses or cattle, several folds of thick woollen horse-rug are sometimes placed round the patient, and hot water from time to time poured amongst the folds. The counter-irritation thus rapidly developed, in careful hands does not blemish, and frequently proves of service in the first stages of pneumonia and pleurisy, colic, enteritis, peritonitis, and obstinate constipation both of horses and cattle.

Cold water is a useful **refrigerant.** When the acute congestion, heat, and tenderness of bruises, strains, and wounds have been so far abated by hot applications, cold exerts wholesome refrigerant, tonic, and constringing effects. Calico

bandages, constantly wetted, relieve chronic strains, jars, and windgalls in the legs of horses. Cold water is also serviceable in broken knees, open joints, and circumscribed burns and scalds; these wounds should not, however, be directly wetted, but kept scrupulously covered by folds of antiseptic lint constantly wetted. Such continuous irrigation is readily effected through a small vulcanised india-rubber pipe brought from a supply tank on a higher level. Cold water similarly supplied keeps at low temperature the swabs around the coronets and feet of horses suffering from laminitis.

Cold water dashed over the head and neck is **a powerful stimulant,** serviceable in megrims, sunstroke, phrenitis, convulsions, syncope, and the comatose stages of puerperal apoplexy in cattle, as well as in poisoning with alcohol, chloroform, opium, and prussic acid, and for encouraging respiration in young animals that breathe tardily at birth. The shock is increased when very cold water is used, and when it falls on the patient from a height of several feet. Such cold affusion must not, however, be long persisted with, as it quickly abstracts animal heat. Equally effectual results are more safely attained by alternately douching with cold and warm water.

Ice in small fragments, placed in the mouth, is readily sucked by most animals, and often **relieves inflammation** of the tongue and throat, and irritability of the stomach, especially in dogs. Applied usually in a bag or bladder, it is serviceable in inflamed and prolapsed uterus and rectum, in piles, herniæ, in those violent bleedings which occur at the time or shortly after parturition; as well as in phrenitis and puerperal apoplexy in cows. Two parts of ice mixed with one of salt form a powerful freezing mixture of the temperature—4° F. Snow or ice is applied to retard the sudden rise of temperature and consequent gangrene in frost-bite, to arrest circumscribed congestion and inflammation, to check bleeding and stop convulsions. Ice remaining in contact with the skin for six or eight minutes removes sensation, so that opening of abscesses, neurotomy, and such operations, may be performed without pain; but for inducing local anæsthesia, cocaine or ether spray is preferable. The curative effects of the ice-bag applied to the spine have already been referred to (p. 143).

WAX.

YELLOW WAX. Cera flava. Prepared from the honeycomb of the Hive Bee, Apis mellifica.

WHITE WAX. Cera alba. Yellow Wax bleached by exposure to moisture, air, and light. (B. P.)

Beeswax is furnished from the glands on the ventral scales of the bee. After removal of the honey, the comb, pressed, fused in boiling water, strained, and poured into moulds, constitutes **yellow wax,** which has a dull yellow colour, a granular fracture, a slightly sweet and pleasant taste and odour; it should be free from greasiness; it is insoluble in cold rectified spirit, but entirely soluble in oil of turpentine. **White wax** is made by melting yellow wax with steam, straining, and decolorising it by exposure in thin ribbons for one or two weeks to air and sunshine, or by boiling with nitrate of soda and sulphuric acid.

Wax has the specific gravity ·960 to ·965, is tough and solid, insoluble in water, soluble in fixed and volatile oils, and in about twenty parts of boiling alcohol, melts at about 145° F., and readily unites with fats and resins. It consists of nearly two-thirds of **cerin,** an imperfectly saponifiable waxy substance; about one-third of **myricin** or melissyl palmitate, a body analogous to spermaceti, and about 5 per cent. of **cerolein,** a soft acid fat. Chinese wax is the product of an insect of the cochineal tribe. Wax is also produced by several plants. The ordinary impurities are starch, detectable by iodine; resin, by its separating on addition of cold rectified spirit; fatty matters by their greasiness and fusibility; inorganic substances by their remaining as a residue when the specimen is burnt or melted and strained.

ACTIONS AND USES.—Wax, although allied to the fats, is much more difficult of digestion, less nutritive, and less demulcent and emollient. Melted with egg or mucilage, it is occasionally prescribed to correct diarrhœa. Its chief use, however, is to increase the consistence and prevent the rancidity of **ointments, cerates,** and **plasters.** Yellow wax, mixed with hogs' lard, or any of the bland fixed oils, is much used for

investing abraded or irritable surfaces, protecting the sound skin from acrid discharges, and preventing corrosives or blisters extending their effects beyond the parts to which their action is to be limited. The **unguentum simplex** is usually made with one part of yellow wax to four of prepared lard; or one part of wax to one and a half each of almond oil and benzoated lard.

ZINC AND ITS MEDICINAL COMPOUNDS.

Metallic zinc, obtained by roasting zinc blende, which is a native sulphide, or calamine, which is a native carbonate. Zinc, alloyed with nickel and copper, yields German silver; when alloyed with copper, it yields brass. A coating of zinc on iron prevents rusting, and constitutes galvanised iron. Zinc is a bluish-white metal, brittle at low and high temperatures, but between 212° and 300° F., it is ductile and malleable. It is diatomic; its salts are colourless.

The Tests for zinc salts are—No precipitate with hydrochloric acid, or with hydrogen sulphide in presence of hydrochloric or other mineral acids. Ammonium sulphide precipitates the white zinc sulphide ($Zn\ S$), soluble in dilute mineral, but not in acetic acid. Caustic potass and also ammonia precipitate the white hydrate $Zn(OH)_2$, soluble in excess of the precipitant. Potassium ferrocyanide gives a white precipitate of zinc ferrocyanide $Zn_2Fe(CN)_6$. Zinc salts fused with sodium carbonate leave a mass which burns with a white flame fringed with green.

Actions and Uses.—Zinc salts coagulate albumin, and hence are **astringents**. As solids and concentrated solutions several, moreover, unite with water, and hence are **caustics.** Although not affecting the unbroken skin, when applied to mucous membranes small doses are astringents, large doses are irritants. The chloride, nitrate, and iodide are readily soluble and diffused, and hence are active and corrosive. The sulphate and acetate, although less energetic, have more activity than the less soluble oxide or carbonate. The sulphate and acetate are prompt **emetics** for dogs and other animals that vomit; unlike tartarised antimony cause little depression

of the circulation, and produce emesis, partly by local action on the stomach and partly by stimulating the vomiting centre in the medulla. They **are absorbed** probably as albuminates, and act as **nerve tonics, astringents,** and anhidrotics, while continued full doses produce symptoms allied to those of lead poisoning. They are eliminated more rapidly than mercury, lead, or copper, in small quantity by the kidneys, but chiefly by the liver and intestinal glands *(Bartholow).*

ZINC OXIDE. Zinci Oxidum. Oxide of Zinc. Zn O.

When metallic zinc or the carbonate is exposed to a red heat in earthen chambers through which a current of air is maintained, the oxide is produced—a soft, nearly colourless, tasteless, inodorous powder, insoluble in water, but soluble without effervescence in acids and in alkalies. When heated, it becomes yellow; but if free from iron, nearly loses its colour on cooling. Under the names of zinc- or china-white it is sometimes substituted for lead oxide for painting; has the advantage of being non-poisonous and not dissolved by hydrogen sulphide, but the disadvantage of not mixing so readily with oils, thus rendering the paint more liable to peel off.

ACTIONS AND USES.—It is a feeble tonic and astringent, and is much used as a topical desiccant, stimulant and astringent. It is occasionally prescribed in catarrh and bronchitis for the arrest of profuse secretion, and is given to dogs in epilepsy.

No astringent is more generally serviceable in relieving the tenderness and itching, and promoting the healing of excoriations and eczema. In exudative erythema, in which it is often desirable to avoid moist dressings, it is dusted over the tender surface mixed with four to six parts of kaolin, sanitas powder or starch flour. In many cases of erythema it is usefully conjoined with glycerin, vaselin, or soft soap. Acute vesicular eczema is often successfully treated by a thorough soaking with mercurous oxide wash and the subsequent in-rubbing of zinc oxide ointment or oleate. Where there is much tenderness or itching such dressings are mixed with or followed by application of morphine oleate. After cleansing the meatus the ointment is useful in canker of the ear of dogs, and in diseases that simulate it.

Doses, etc.—Horses and cattle take ʒij. to ʒiv.; dogs, grs. ij. to grs. vj., given in bolus or solution. For external use **aqueous solutions** are made with equal parts of zinc oxide and of borax or other alkaline salt or glycerin added to ensure solution, with 10 to 30 parts of water. **Liniments** and **ointments** are prepared with one part of oxide to 5 or 6 of olive oil, vaselin, or other fatty matters. Some cutaneous complaints in which ointments freely used are apt to impair secretion and excretion, and others which should not be wetted are satisfactorily treated by **pastes** or **powders.** Zinc oxide suits well for such purposes, and may be applied mixed with kaolin, silicious earth, or magnesium carbonate.

Zinc Carbonate. Zinci Carbonas. Carbonate of Zinc.

Calamine, the native carbonate, is an important ore of zinc. The B. P. carbonate—white, tasteless, and insoluble in water —is usually prepared by boiling together nearly equal weights of zinc sulphate and sodium carbonate, and is a mixture of carbonate and oxide with water of crystallisation ($Zn\,CO_3$ $(Zn_2HO)_2$. 3 Aq). Its uses are identical with those of the oxide.

Zinc Sulphate. Zinci Sulphas. Sulphate of Zinc. White Vitriol. $Zn\,SO_4.\,H_2O$. 6 Aq.

Zinc blende, the native sulphide (Zn S), when roasted, yields a crude sulphate. The B. P. salt is got by dissolving granulated zinc in diluted sulphuric acid, getting rid of any iron or tin by chlorine solution, and adding zinc carbonate. It occurs in colourless, transparent, long prisms, isomorphous with those of Epsom salt, with a styptic metallic taste, and efflorescent in dry air. It is insoluble in alcohol, soluble in less than its own weight of boiling water, and in about twice its weight at 60° F. Heated, it melts in its water of crystallisation, six of the seven water molecules are expelled; at higher temperatures it is decomposed, and oxide is left. Any metallic impurities are deposited on a strip of metallic zinc placed in the solution.

Actions and Uses.—It is irritant, emetic, astringent, antiseptic, and nerve-tonic. It is used externally as a stimulant, astringent, and antiseptic.

Toxic Effects.—**Horses** and **cattle** take doses of several ounces without apparent injury. Orfila found that $7\frac{1}{2}$ drachms were vomited by **dogs** in a few seconds, but produced no lasting bad effects. When vomiting, however, was prevented by ligature of the œsophagus, much smaller quantities sufficed to destroy dogs, in about three days, from gastro-enteritis. Thirty grains in solution, injected into the veins, depressed the action of the heart and destroyed life in a few seconds (*Christison On Poisons*). Emesis, although remarkably prompt and full, is seldom accompanied by the nausea and depression produced by tartar emetic. Repeated doses are detected in the spleen, liver, fæces, and urine. Unlike lead or mercury, it does not exhibit any cumulative action. Two horses had each half an ounce for a fortnight without effect; but an ounce repeated thrice a day impaired appetite, and caused nausea with diuresis (*Veterinarian*, January 1844).

Medicinal Uses.—As a **tonic** it resembles, but is inferior to, iron and copper sulphates. As an **astringent** in diarrhœa or dysentery, it is given with opium, but is less serviceable than copper sulphate or lead acetate. For arresting spasmodic diseases in the lower animals, it is not so effectual as copper sulphate, arsenic, or quinine. It checks acute chorea in dogs in good condition; but iron is better in chronic cases associated with debility. For drying **excessive discharges,** especially from the alimentary canal, and for checking undue perspiration and hæmorrhage, frequent small doses are given with sulphuric acid and opium. As a safe and prompt **emetic,** it is prescribed for dogs and pigs to empty the stomach of undigested food, foreign bodies, and poisons.

Externally, it is much used as a **stimulant** and **astringent** in weakly, over-secreting wounds, in foul ulcers, simple ophthalmia, relaxed sore throat, irritable conditions of the mucous membrane of the uterus or vagina, vesicular and pustular skin eruptions, and interdigital inflammation in sheep.

Doses, etc.—As an emetic for dogs and pigs, grs. viij. to grs. xv. are given in two or three ounces of water. As an astringent and tonic for horses and cattle, ʒj. to ʒiij.; for sheep, grs. x. to grs. xx.; for dogs, grs. j. to grs. iij. are given

either in the solid or fluid state. **Externally,** it is used in powder or solution, usually made with 30 to 60 parts of water. Three-quarters of an ounce of zinc sulphate and an ounce of lead acetate, dissolved in a quart of water, constitutes the **White Lotion** so familiar in veterinary practice.

Zinc sulpho-carbolate is sometimes used as an antiseptic and astringent, 2 to 5 grains being dissolved in an ounce of water (p. 315).

ZINC CHLORIDE. Zinci Chloridum. Butter of Zinc. $Zn\ Cl_2$.

When metallic zinc or the oxide is boiled in hydrochloric acid, the solution evaporated to dryness, and the residue melted, there remains the greyish-white, opaque, waxy-looking deliquescent chloride, usually moulded into sticks, possessing an astringent metallic taste, and soluble in water, alcohol, and ether.

ACTIONS AND USES.—It is an irritant and corrosive poison. Medicinal doses are antiseptic, astringent, and tonic, but it is scarcely ever given internally. Externally, it is applied as a stimulant, astringent, caustic, and parasiticide. It is also used as an antiseptic, disinfectant, and deodoriser.

SURGICAL USES.—From its strong attraction for water, and its coagulating albumin, it is an **energetic caustic.** It resembles mercuric and antimony chlorides. It is used to control luxuriant granulations, unhealthy ulcerations, and foot-rot in sheep, and for such purposes is sold in pencils similar to those of silver nitrate. To remove malignant growths and slough away the cartilaginous secreting surfaces of fistulæ, it is introduced, usually mixed with 2 parts of flour made into a paste with water, or gently heated with 2 parts of gutta-percha. Unlike arsenic or mercury salts, it is not liable to undergo absorption, and produce constitutional mischief. Forty grains to an ounce of water are used for cleansing envenomed wounds, and those not easily got at by solid caustics, and are serviceable where repeated dressings are inadmissible, and the volatile carbolic acid cannot be conveniently replaced. Such solutions secure the aseptic state of wounds preparatory to their being covered in by carbolic or other antiseptic dressings, and they also destroy skin vermin.

Like mercuric chloride, it is serviceable for keeping animal tissues for dissection. Its antiseptic effects are exerted even in the presence of considerable quantities of water, which interfere with the efficacy of the tar acids. Besides preventing and arresting putrefaction, it also decomposes hydrogen sulphide, ammonia, and other offensive products of decay. **Sir William Burnett's Disinfecting and Antiseptic Fluid** contains 25 grains zinc chloride in every fluid drachm, and is ordered to be used in the proportion of one pint to five gallons of water. **Professor Tuson's Disinfectant Powder and Solution** consist chiefly of zinc chloride and sulphurous acid.

ZINC ACETATE. Zinci Acetas. Acetate of Zinc.
$Zn(C_2H_3O_2)_2$. 3 Aq., or $Zn(CH_3CO_2)_2$ 3 Aq.

Zinc acetate is prepared by dissolving metallic zinc, its oxide or carbonate, in dilute acetic acid. When three-quarters of an ounce of zinc sulphate and an ounce of lead acetate are dissolved in a pint of water, mutual decomposition ensues, lead sulphate is precipitated, zinc acetate remains in solution, which, if decanted or filtered, constitutes the **White Lotion** so extensively and successfully used by the late Professor Dick. For most stimulant and astringent purposes this strong lotion requires dilution with at least another pint of water. Zinc acetate crystallises in colourless, odourless, pearly, rhomboidal plates, which have a sharp, disagreeable, metallic taste, are readily soluble in water, and, when heated with sulphuric acid, evolve the characteristic acetous odour.

ACTIONS AND USES.—The acetate closely resembles the sulphate. It is emetic and nerve tonic, but is seldom used internally. Externally, as a stimulant and astringent, it promotes healing of wounds, dries excessive serous and pustular discharges, relieves erythema, eczema, and impetigo, as well as conjunctivitis and other superficial inflammations. Professor Tuson (*Veterinary Pharmacopœia*) recommended a solution for saturating at short intervals the wash-leather bandages applied to the jarred, swollen legs of hunters. According to the purposes for which it is used, 2 to 20 grains are dissolved in the ounce of water.

APPENDIX.

Professor Fred. Smith and Professor Charles Rutherford, of the Army Veterinary School, Aldershot, have most kindly placed at my disposal the following valuable unpublished notes of the hypodermic injection of small doses of aconitine, aloin, and atropine. The subjects were healthy, well-bred horses; the drugs were injected into the anterior part of the chest. Under their respective headings the records have previously been given of various published experiments which these gentlemen have made with physostygmine (p. 281), pilocarpine (p. 429) and morphine, (p. 510).

ACONITINE.

A solution was used consisting of 1 grain of alkaloid in 480 minims—1 fluid ounce of water. The injections were made hypodermically in the anterior region of the chest.

Case I.—Bay gelding, aged, healthy—pulse 38, firm; respirations 10 per minute; temperature 100$\frac{2}{5}$ F.; feeding well, fæces soft.

3.22 10 minims solution injected.
3.29 Biting and licking site of puncture.
3.33 Began pawing most incessantly.
3.37 Pulse 48, firm; respirations normal.
3.40 Shaking of head and yawning.
3.46 Walking round box or pawing; ears laid back, frequently rubbing hip against manger.
4 Rubbing hip, licking breast, pawing or on move and uneasy, yawning and sneezing.
4.14 Pulse 40, firm; temperature 100$\frac{1}{10}$.
4.15 to 4.30 Much the same.
4.40 Quieting down, temperature 100$\frac{2}{5}$.
4.50 Quiet.
5 Was fed and ate heartily.

Case II.—Gelding, aged, in good health—pulse 42, soft; respirations 12; temperature 100$\frac{1}{10}$.

3.27 Injected hypodermically at breast 10 minims aconitine solution.
3.40 Pawing a little.
3.47 Passed fæces and drank some water.

4.1 Pawing and shaking of head most persistently.

4.5 to 4.10 Only a little pawing; pulse 44, soft; respiration normal; temperature $99\frac{9}{10}$.

4.15 Quiet.

4.45 Went to water, drank well, no "glutting."

4.50 Temperature 100; pulse 44, soft.

5.5 Quiet.

Case III.—A very quiet gelding—pulse 44; temperature 100°.

4.12 Injected 15 minims aconitine solution as above, mixed with 15 minims water.

4.30 Shaking of head, yawning, and licking of breast.

4.43 Pulse 48, firmer; temperature 100°.

4.53 Coughing and very uneasy; no pawing.

5 Been coughing frequently.

5.5 Pulse softer; temperature 100°.

5.15 Still uneasy, rubbing head against manger, tossing of head, occasional pawing with fore-feet.

5.32 Pulse 48, soft; temperature 100°.

5.50 Perfectly quiet.

Case IV.—Bay mare, 12 years old, 16 hands—pulse 38, soft; respirations 18; has a pendulous lower lip; fæces of moderate softness; released from work at 12.15, fed at 12.30; weather warm, stable warmish.

4.21 15 minims aconitine solution, as above, injected hypodermically at breast.

4.25 to 4.35 Excited, pawing, walking round box, yawning; the pendulous lower lip is raised to a more normal position; pulse 44, and soft; breathing jerky at times, and 18 per minute; face anxious, ears thrown back, tail cocked, licking breast at injection spot.

4.35 to 4.45 Eyes bright, pulse 46 and a shade firmer; took no notice of a waggon passing the box; otherwise same as above.

4.45 to 4.55 An occasional "belch;" switching of tail, sneezing; when not on move, stands pressing hip or tail against the wall, or is licking at the breast; pulse 52, and decidedly firmer.

4.55 to 5.5 Occasional pawing and switching of tail, and cough; seat of injection moist; face indicative of pain.

5.10 to 5.15 Coughing, frequent sneezing, pawing, uneasiness, moving about; pulse softer.

5.17 On passage of a barrow outside she brightened up, cocked her ears, and looked out.

5.18 Head in corner, rubbing nose against the wall, on move again, throwing up head.

5.25 Coughing badly, and pawing.

5.30 Paddling of hind feet, rubbing quarters on wall.
5.35 Seat of injection becoming dry, but quieter; occasional cough.
5.40 Pulse 52, soft; respirations 36.
5.50 Occasional coughing and pawing; glutting a little now and then, and on move around the box.
5.50 to 6 Coughing and sneezing frequently; still on move, and pawing; grinding teeth; pulse 48, soft; respirations 24.
6.15 Dunged, excretion normal in quantity and appearance.
6.20 to 6.40 Quieting down gradually; pulse 40; respirations 20.
6.50 Quite quiet.

ALOIN.

Case I.—5 grains aloin dissolved in water were injected hypodermically into the breast of a healthy horse, but no effects were notable.

Case II.—8 grains dissolved in weak spirit were injected into the right jugular vein of a healthy horse, but, although pain and swelling of the vein supervened, there were no evidences of gastro-intestinal disturbance.

Case III.—10.55 12 grains injected hypodermically.
12 One dropping, pellets hard and dark-coloured.
12 to 1.30 No droppings, animal quiet and dull, circling round box.
1.30 One dropping, hard, dark, scraping with fore feet.
2 Droppings, lying down apparently in pain.
2.30 Scraping, circling round box.
3 to 3.30 Very uneasy, and restless at intervals.
4 Very dull, lying down.
4.30 Restless, inclined to lie down.
5 Increased restlessness.
5.30 Lying down, droppings still hard and dark.
6 Scraping, and circling round box.
Effects gradually wore off.

Case IV.—10.55 24 grains injected into chest.
11.30 One dropping, pellets hard, dark-coloured, animal quiet.
12 Animal quiet, no change.
12.30 Fed; rumbling in intestines.
1 Inclined to scrape while feeding.
1.30 Uneasy, droppings hard in pellets.
2 Quiet, dull and sleepy.
2 to 3 Lying down, sleepy, head inclined to left side; slight twitching of muscles of face and lips.
3.30 Circling round box, scraping.
4 Eyes heavy and dull, droppings hard.
4.30 Scraping while feeding.

5 Circling round box, pain increasing.
5.30 Droppings still in hard pellets; seems in great pain.
8.45 Droppings in pellets hard and dark, scraping occasionally, still in pain, animal seemed much exhausted.

Effects gradually passed away, but without the bowels being notably relaxed.

ATROPINE SULPHATE.

The experimenters injected hypodermically into the chest of healthy horses the B. P. liquor atropinæ sulphatis, which contains one grain of the drug to about 100 fluid grains of water. In different experiments they used 15, 20, and 25 minims of this solution. But such injections produced no notable effects. Increased doses gave the following results:—

Case I.—Bay gelding—pulse 36, soft; respirations quiet, 10; mucous membranes pinkish, mouth warm and moist; pupil ½-inch vertical diameter. Feeding well, receiving hay and grass only; weather warm, about 60° F.

12.35 Hypodermic injection of 30 minims of solution.
1.15 Eyes dull, lids drooping and heavy-looking, but pupil same as before experiment began, and the animal does not sleep; pulse 32, a shade firmer; no change in state of membranes or mouth.
2 Effects passed off.

Case II.—Chestnut mare—pulse 30, soft and very intermittent; respirations 10; mucous membranes of eye and mouth very pale pink, mouth moist and warm; pupil ⅜-inch vertical diameter; feeding well on hay.

12.45 Injected hypodermically 30 minims of solution.
1.15 Pulse 28, soft, intermittent; pupil ½-inch diameter; no change in respiration or appearance of mucous membranes or mouth; eyes dull, heavy, sleepy looking, but so far from being asleep, she is very easily excited.
2 All the above appearances passed off.

Case III.—Bay gelding—pulse 28, firm, very soft; respirations 8; mucous membranes ruddy pink, mouth warm and moist; fæces firm; urine light coloured; pupil ⅜-inch in vertical diameter, body warm, legs cold; feeding well; weather a little cold.

3.15 Injected 50 minims solution.
3.55 Pulse 30, soft, firmer; respirations, mucous membranes, and mouth same as before; stands quiet, with head facing back of box; pupil ½-inch diameter.
4.20 Standing very quiet, looks occasionally somewhat dull; pulse 28, fairly firm; respirations, mucous membranes, and state of mouth unchanged.

4.45 For last five minutes has been incessantly rubbing his lips against the door; opening mouth widely, smacking lips; occasional spasmodic expiration, half sneeze and half cough; but he has lost slight dull appearance of the eyelids.

4.55 Pulse 28, soft; occasionally opening mouth, rubbing lips, but bright, and looking out for food.

Case IV.—A mare received 60 minims hypodermically. The pulse in about half-an-hour fell from 32 to 26. She stood quiet, and was a little dull; occasionally smacked her lips; but in little more than $1\frac{1}{2}$ hours she looked bright and neighed for food.

Case V.—Bay gelding—pulse 30, fairly firm; respirations 8; pupil $\frac{3}{8}$-inch vertical diameter.

10.45 Hypodermic injection of 120 minims.

10.53 Yawned five or six times.

11.5 Pulse 26, soft; pupil $\frac{1}{2}$-inch vertical diameter; quiet.

11.20 At times very quiet, at other times playing with door-latch; pupil $\frac{1}{2}$-inch diameter.

11.30 No change. Effects quickly passed away.

Case VI.—Chestnut mare—pulse 28, fairly firm; respirations 10; mouth moist and warm; mucous membranes yellowish pink; pupil $\frac{3}{8}$-inch vertical diameter; fæces firm; feeding well on hay; weather coldish.

10.40 120 minims solution injected.

10.55 Occasional smacking of lips.

11.10 Pulse 18, very soft, intermittent at every second or third heart-beat; pupil $\frac{1}{2}$-inch diameter; animal quiet.

11.15 Frequent smacking of lips; with door of box closed and watched she appears a little sleepy, but is very easily roused; pupil $\frac{1}{2}$-inch diameter.

11.30 No change to be noticed from healthy state.

Case VII.—Bay gelding—pulse 30, very soft; respirations 7; pupil $\frac{3}{8}$-inch vertical diameter; feeding well on hay; weather cold.

11.24 Injected hypodermically 180 minims.

12 to 1 Has appeared quiet at times, but is easily disturbed. No sleepiness or sedative effect.

4 No abnormal appearances.

Atropine, in two experiments, was administered by intra-tracheal injection in doses of $\frac{3}{10}$ grain, and caused immediately a gulp and cough; but the only notable appearances were dryness of the mouth, with slightly increased fulness and quickening of the pulse—conditions which were observable about three-quarters of an hour after the injection, and shortly disappeared.

INDEXES.

INDEX OF DISEASES AND REMEDIES.

ABORTION.

Slipping; Premature Birth; Accidental and Epizootic; occurs especially in cows and ewes.

Isolate animals aborting from pregnant animals.

Burn, thoroughly disinfect, or deeply bury fœtus and placenta.

Cleanse and thoroughly disinfect premises in which animal has aborted.

Irrigate uterus, vagina, external organs, and tail root with effectual germicide.

One part corrosive sublimate, 40 common salt, 4000 clean rain-water, or 1 part each mercuric iodide and pot. iodide in 1000 water, safe and effectual.

With this solution inject repeatedly genital passages of animals that exhibit premonitory symptoms.

Use similar injections as preventive for animals that have herded with those that have aborted.

Accidental cases resulting from injuries, strains, gastric derangement, or eating ergotted food, with quiet and isolation, should also have injection treatment.

Prevent use of bulls with balanitis.

ABSCESS.

Swelling, containing serum or pus.

Fomentations, poultices, water dressings relieve tension and pain.

When maturing tardily, apply counter irritants—mercury oleate or iodine around or adjacent.

Evacuate when ready with knife, especially when deep-seated.

When deep-seated, superficial parts, before opening, may be anæsthised with cocaine or ether spray.

Dress antiseptically.

Healing of chronic abscess when opened helped by antiseptic injection.

Belladonna inunction relieves pain.

Salines, sulphides, belladonna internally tend at outset to abort abscess.

Alkaline sulphites in more advanced stages hasten suppuration.

ACARI MITES.

Produce skin irritation, itching, occasionally eruption. See MANGE and SCAB.

Soft soap, alkalies, and hot water cleanse skin, remove scales, and lay bare burrows.

Soaking with oil facilitates removal of crusts.

As parasiticides rub in sulphur, or sulphur iodide ointments, mercury oleate, carbolic or tar oils, stavesacre or corrosive sublimate solutions.

For dogs—aniseed or other volatile oils, wood tar oils.

For sheep—solutions of tobacco, tar oils, arsenic, corrosive sublimate. Separate affected from healthy. Narrowly watch suspected. Disinfect premises, racks, rubbing posts, &c.

ACTINOMYCOSIS.

Clyers: A vegetable parasite or epiphyte, probably originating in certain plants, thence introduced into the bodies of animals, and probably through abrasions in the mucous or other membranes, producing granulomata, nodules, or tumours, found chiefly on tongue and jawbones of cattle, spermatic cord of horse, udder of sows, &c.

In early stage excise diseased structures.

Scrape and dress with iodoform; a mixture of iodine, carbolic acid, and glycerin; iodine tincture, or other antiseptic.

Hydronaphthol, borax, or other non-poisonous antiseptic as subsequent dressing when disease affects tongue or mouth.

Precautions to prevent parasite being transferred to healthy subjects.

Generous diet; tonics.

ACIDITY OF STOMACH.

Pyrosis.

Change of food, which should be digestible, unstimulating, and rather restricted in amount.

Half a dose of physic will remove any irritant.

Mineral acids, given before or with food.

Alkaline bicarbonates as palliatives.

Lime water and chalk when diarrhœa present.

Magnesia or magnesium carbonate when constipation present.

Place a piece of whiting and of rock salt in horse's manger.

Conjoin antiseptics with antacids when associated with flatulence.

Bismuth and opium when accompanied by irritation.

Gentian, nux vomica, and other bitters when resulting from atony.

Silver oxide, tannin, lead acetate, when associated with gastric catarrh.

ACNE.

Inflammation of sebaceous follicles and glands leading to eruption of pimples.

Hot fomentations; water dressing; alkaline solutions, such as saturated solution sodium bicarbonate, borax, glycerin and water; sulphur iodide.

See to fitting and proper lining of harness.

Sulphur, both locally and internally. Belladonna extract, hydrocyanic acid, or Goulard's extract relieve local irritation.

Salines and arsenic internally in chronic cases.

AFTER PAINS.

Post-partum pains; Heaving.

Remove placenta and clots from uterus; raise hind quarters.

Syphon into uterus, antiseptics and anodynes: carbolic acid, Condy's red fluid, mercuric iodide or chloride, with belladonna and opium.

Ergotin hypodermically, if uterus flaccid and dilated.

Administer chloroform or chloral, with cannabis indica, or belladonna.

Morphine and atropine hypodermically in persistent cases.

Laxatives and enemata to empty bowels; draw away milk.

ALOPECIA.

Baldness.

Oleaginous diet; tonics; sulphur iodide.

Stimulate skin with ammonia liniment; cantharides tincture, 1 part; soap or camphor liniment, 8 parts; or castor oil.

Shave, and rub in vaselin daily, dressing occasionally with above stimulants.

AMAUROSIS.

Gutta serena; Glass eye; Paralysis of optic nerve and retina.

Unless when depending upon brain derangement or debility, it is incurable.

AMAUROSIS—*continued.*

Blisters, setons around orbit.

Strychnine in traumatic cases and those of nerve atrophy, but unsuitable where there are brain symptoms.

ANÆMIA.

Hypœnia; Bloodlessness.

Generous diet, containing suitable proteids and fats.

Comfortable quarters; pure air; exercise; clip horses with heavy coats.

Iron salts, and occasional laxatives.

Gentian, quinine, and other bitters where appetite faulty.

Mineral acids, where gastric mucous membrane soft and relaxed.

Arsenic, after iron has been persisted with for ten days, or where iron disagrees.

Calcium phosphate in growing young animals; Parrish's syrup, alternated with Donovan's solution.

ANEURISM.

A tumour containing blood communicating with interior of artery.

Equable pressure; truss; bandages; acupressure; cat-gut ligature.

Aconite relieves pain and lowers circulation.

Ergotin locally injected contracts vessels.

Potassium iodide internally encourages absorption.

Rest and quiet; careful, rather low diet.

Electrolysis, injection of ferric chloride, lead acetate, or ergotin may cause coagulation within sac.

Radical cure and obliteration of vessel by continuous digital acupressure.

ANGLE BERRIES. See also WARTS.

Remove with knife, torsion, caustic, or ligature; dress antiseptically.

ANTHRAX.

Charbon: A group of specific febrile diseases, caused by a micro-organism, communicable from one species of animal to another. The several forms are sudden in their attack, and many of them are speedily fatal.

Curative treatment where attempted consists in free administration of non-poisonous antiseptics—pot. chlorate, sodium sulphite, or hydronaphthol, or of carefully regulated doses of carbolic, ferric chloride, or mercuric iodide or chloride.

Carbolic and other antiseptics, injected hypodermically.

Promote action of bowels and other excreting channels.

Scarification of malignant pustule or other limited accessible swelling, and dressing antiseptically.

Preventive treatment consists in protection from access of bacillus and spores.

Burn or deeply bury diseased carcases and infected discharges.

The flesh of animals dying from anthrax has produced the disease in pigs, and occasionally in dogs which have eaten it.

Thoroughly disinfect infected premises.

Keep animals off pastures where disease has occurred, and from low-lying swampy districts and other situations affording favourable habitat for the micro-organism.

Innoculation with cultivated virus protects against attacks of several forms of anthrax.

Carbuncular fever; Glossanthrax, resembling malignant pustule in man; Loodiana; Cape sickness *in horses.*

Cicatrise local swellings and dress with iodoform, with 3 per cent. carbolic solution or other antiseptic. Curative and preventive treatment as above.

Splenic apoplexy, chiefly in adult cattle and sheep.

Onset of attack and death sometimes occur within a few minutes.

ANTHRAX—*continued.*

Intra-venous injection of cultivated virus protects healthy subjects.

Black-leg; Quarter evil; Symptomatic anthrax, chiefly *in young cattle and sheep.*

Free scarification of limited external swellings and introduction of antiseptics appear to arrest some slight cases.

Intra-venous injection of virus usually ensures immunity from attack.

Setons produce condition of body less favourable to development of micro-organism.

General preventive treatment as above.

Texas fever; Spanish fever: A contagious cattle fever, probably depending on a micrococus, and originating in the swampy lands of Southern Texas.

Digestible food; antiseptics; tonics.

Infected Texans must be isolated, for the disease increases in virulence when it attacks cattle at some distance from original habitat of the disease.

Glossanthrax; Blain; Carbuncle; chiefly affecting the tongue; occurs in most of the domestic animals.

Scarify and dress with antiseptics.

Chlorine, iodine, bromine vapour inhaled; antiseptics internally; generous diet, tonics, and stimulants sustain patient.

Anthracoid erysipelas and carbuncular fever in pigs.

Emetics and laxatives in earlier stages help to remove virus and products of disintegration.

Syringe patient with sulphurous acid solution.

Careful segregation of infected and suspected from healthy subjects.

Further preventive treatment as above.

Poultry anthrax: Malignant pustules appearing on various parts of body, and affecting internal organs.

Only exterminated by killing, burning, or deeply burying infected, and by continued thorough disinfection.

APHTHA.

Vesicles in the mouth; Thrush; associated with the epiphyte, oïdium albicans.

Alum, borax, suphurous acid, chlorine or potassium chlorate solutions applied locally. Electuaries of oxymel, glycerin and water, and glyceride of starch.

When connected with gastric derangement, give laxatives, salines, hydrargyrum cum creta.

When patient reduced prescribe tonics.

Soft digestible food.

APHTHOUS OR VESICULAR EPIZOOTIC.

Foot and mouth disease; Eczema contagiosa: A contagious eruptive fever affecting cattle, sheep, pigs, and occasionally poultry.

Segregate affected; disinfection; soft digestible food.

Keep inflamed abraded surfaces clean, and moisten occasionally with alum, borax, or zinc sulphate, made up with treacle, honey, or glycerin and water.

Lead or zinc acetate solution or ointment, Goulard's extract or Condy's fluid diluted, applied to udder and feet.

Milk cows frequently and prevent lodgment in udder of stale milk.

Pot. nitrate and chlorate, mixed with mash or drinking water, when fever high.

APOPLEXY, CEREBRAL.

Usually due to degeneration (atheroma) of blood-vessels of the brain, but not common in domestic animals.

Blood letting and aconite blister behind the ears lower arterial pressure in earlier stages, or where attack threatened.

APOPLEXY, CEREBRAL—*continued.*
Active purgatives, seconded by laxative clysters, relieve congestion.
Cold water and ice to head.
Digestible laxative food ; avoidance of over-exertion, or exposure to heat of sun.
Iodine and pot. iodide promote absorption.
Nitro-glycerin and bromides diminish cerebral congestion.
Recurrence of attacks in robust subjects prevented by careful dieting, venesection, and seton in poll.

APOPLEXY, PARTURIENT.
Milk fever : An apoplectic disease occurring in cows and ewes at or immediately after parturition, probably depending upon embolism of cerebral vessels, caused by fat globules.
Bleed in earliest stage.
Cathartics, active—salts, with calomel, gamboge, or croton, treacle, and aromatics.
If swallowing difficult, give this and other medicine with Reid's pump.
Prop on sternum ; keep up head ; turn patient from one side to other every three hours.
Remove milk every few hours and rub bag.
Empty urinary bladder by catheter twice daily.
Ice or refrigerants to head ; clothe and rub body and legs.
Linseed gruel occasionally by stomach pump and clyster.
Alcohol, conveniently in form of whisky, with ammonia solution and carbonate, where collapse threatened.
Rubefacients to spine.
Until recovery fairly established, prevent eating of dry food, but allow mashes and diluents.
The paralysis sometimes resulting treated with purgatives, counter-irritants to the spine, potassium iodide and nux vomica.
Prevent by sparingly feeding susceptible subjects for a month before calving.
Dose physic fortnight before parturition expected, and another so soon as it occurs.
Milk cow a fortnight before calving, earlier if milk can be drawn, and empty bag twice daily.

APOPLEXY, PULMONARY.
Congestion or engorgement of lungs ; occurring in horses usually from violent over-exertion, leading sometimes to inflammation.
Cool air to breathe ; smart hand-rubbing of body and limbs, which must subsequently be warmly clothed.
Small repeated doses of alcohol, ether, or ammonia stimulate cardiac and respiratory centres.
Abstraction of blood from jugular relieves congestion of right heart.

APOPLEXY, SPLENIC. See ANTHRAX.

APPETITE IMPAIRED.
Varied and tempting diet.
Food removed if not eaten, and fresh supply presented at next meal.
Examine teeth, mouth, and throat, and look for gastric or other cause.
Acids, bitters, cannabis indica.

ARTERITIS.
Inflammation of arteries ; not common in the lower animals.
Rest ; alteratives ; salines ; blister if vessel superficial.

ARTHRITIS.
Inflammation of joints. See SYNOVITIS and OPEN JOINT.

ASCARIDES. See WORMS.

Ascites.
Dropsy of the abdomen.
Diuretics; salines; oil of turpentine; digitalis in cardiac complications.
Endeavour to combat any hepatic or cardiac disease, on which condition frequently depends.
Generous diet and tonics, when resulting from anæmia or scrofulous disease of peritoneum, which occurs in cattle and sheep.
Concentrated dietary, iron salts, and turpentine, in sanguineous form appearing in impoverished sheep and lambs.
Tapping, even when it does not cure, relieves distressing symptoms.

Asthma in Horses. See Broken Wind.

Asthma in Dogs.
Paroxysm checked by cautious inhalation of anæsthetics, amyl nitrite, or nitro-glycerin, or by chloral given by mouth.
Bromides; strong coffee internally.
Emetics relieve many cases associated with bronchial symptoms.
Inhalation of terebene with or without steam; of stramonium with pot. nitrate and chlorate, or amm. chloride.
Aconite in spasmodic cases in robust patients.
Belladonna, stramonium, sometimes with eucalyptus, internally or inhaled.
Alkalies, amm. chloride, pot. iodide; inhalation of sulphur fumes when associated with dry bronchial catarrh.
Oil of turpentine; asafœtida; benzoin; eucalyptus oil when discharges profuse.
Strychnine internally or hypodermically when respiratory centre weak.
Acids and arsenic when complicated with gastric derangement.
Occasional dressing of throat with stimulant embrocation, especially in old dogs with bronchial symptoms.
Regular digestible, rather concentrated, diet.

Atheroma.
Arterial degeneration.
Avoid over-exertion; digestible oleaginous dietary.
Ammonium iodide promotes absorption.
Iron salts, phosphates, Easton's syrup in debilitated patients.
Phosphorus in small doses where brain vessels implicated.

Atrophy.
Wasting; Emaciation.
Suitable diet; proper use of wasted part; tonics, arsenic, and strychnine internally.
Friction, massage, electricity; inunction of oil, cantharides, or mercuric iodide blister also serviceable in muscular atrophy.

Azoturia. See Hæmoglobinuria.

Balanitis.
Inflammation of mucous membrane of penis; contagious, especially when of specific or impure form.
Zinc sulphate or lead subacetate, diluted solutions.
Zinc oxide ointment.
Laxative: anodyne enemata.
Chronic specific cases often caused by leucorrhœa in female, accompanied by effusion and pain, and require scarification and continued fomentation.
Horse or bull must be cast and secured; inflamed ulcerated surfaces dressed with zinc oxide oint. carbolised, or mercuric nitrate oint.
Perfect rest; dose of physic; laxative diet.

Barrenness.
Change of diet and surroundings; exercise.
Alteratives; pot. iodide; phosphorus and cantharides, small doses.
Gradual lowering of fat plethoric subjects.
Improved condition of debilitated by diet and tonics.
Dilatation of os uteri if it be impervious; change male.

BELLONES.
Horses with polypus or tumour in nasal passages.
Excise polypus by forceps; dress antiseptically.
Pads over nostril sometimes diminish noise.

BITES OF INSECTS.
Ammonia, pot. hydrate or pot. bicarbonate solutions.
Carbolic acid; prussic acid; chloroform; cold water dressings.

BLACK-LEG OR BLACK QUARTER. See ANTHRAX.

BLADDER, INFLAMMATION OF. See CYSTITIS.

BLADDER, IRRITABLE.
Diluents; linseed tea; suitable diet. Interdict heated grain or fodder, or other acrid food.
Laxative relieves any gastro-intestinal irritation.
Belladonna, as anodyne, used internally and locally.
Benzoic acid or ammonium benzoate when urine alkaline.
Alkaline bicarbonate when urine acid.
Copaiba and cubebs as antiseptics in chronic cases.
Sulphuric and salicylic acids, with iron sulphate where irritation in horses is connected with influenza or purpura.
Anodyne enemata benefit reflexly.
Cleanse with soap and water prepuce and external meatus of male.

BLADDER PARALYSIS.
Prevent accumulation of urine by use of catheter, or by gentle pressure on viscus from within rectum.
Prescribe cantharides, ergot, or cannabis indica; nux vomica when atonic.

BLEEDING. See HÆMORRHAGE.

BOG SPAVIN.
Distension, in acute case inflammation of hock-joint of horse.
Rest; high-heeled shoe.
In all acute cases rest best secured by slinging.
Foment when joint hot and tender.
Cold water and refrigerants when acute inflammation abated.
Spring truss in young animals sometimes used to give equable pressure.
Counter-irritation encourages absorption; firing-iron or seton in chronic cases.

BOILS. See also ABSCESS.
Mercuric nitrate or belladonna ointment, or painting with silver nitrate, sometimes aborts in early stages.
Fomentations and poultices hasten maturation and relieve pain.
Counter-irritants around inflamed spot hasten suppuration.
Anodynes locally relieve irritation and pain.
Laxative diet; alkaline sulphites and chlorates; calcium sulphide internally.
When opened, treat antiseptically.
Arsenic internally sometimes prevents recurrence.

BONE SPAVIN. See SPAVIN.

BOTS.
Larvæ of œstrus equi.
Turpentine and oils; bitters; hydrochloric acid; copper and iron sulphates; arsenic; followed by purgatives.
Green fodder; destroy larvæ and fly.

BOWELS, INFLAMMATION OF. See ENTERITIS.

BRAIN, INFLAMMATION OF. See PHRENITIS.

BRAXY IN SHEEP.
A form of septic æmia depending upon a microbe, characterised by patches of congestion and echymosis, chiefly affecting the mucous and serous membranes and skin.
Most cases prove fatal.
Prevent by carefully regulated dietary.
Removal from exposed, undrained, infected grazings.

BROKEN KNEES IN HORSES.
In slighter cases where skin not broken, tie up head and apply zinc or lead acetate solutions, diluted for two or three days.
When skin cut cleanse thoroughly, dress antiseptically, bring edges together with plaster, styptic colloid, or shellac paste; retain them in position with light calico bandage; dress with mild astringent solutions.
When skin considerably lacerated, tendon and its bursa bruised and exposed, or knee-joint opened, the limb should be put in splints and animal slung; astringent and antiseptic dressings and cold water, allowed to trickle over calico bandage moderate inflammation.
When tendon much crushed, knee-joint laid open, bones seriously injured or fractured, anchylosis must ensue, and the animal had better be destroyed.
Professor Williams' *Principles and Practice of Veterinary Surgery.*

BROKEN WIND IN HORSES.
A form of asthma, usually resulting from gastric derangement.
Incurable, but relieved by careful dietary; good concentrated food given damped; water frequently, in limited quantity at a time, but withheld before hard, fast work.
Laxatives and salines given occasionally.
Rock salt, chalk, or whiting in manger.
Linseed oil, with lime water, daily in drench or with food.
Arsenic, grs. iss. or grs. ij., in form of Fowler's solution, given daily or every second day, may be continued for months.
Professor Dick's cough balls occasionally.

BRONCHIAL FILARIA. See WORMS.

BRONCHITIS, ACUTE.
Place in comfortable box, 60° to 65° F.; cool, pure air to breathe; body and limbs clothed.
Inhalation of watery vapour from steam kettle, large mash, or bucket of boiling water, promotes exudation in dry stage.
Inhalation medicated as required by expectorants, anodynes, or antiseptics.
Fomentations and mustard to throat and sides.
Mustard in earlier stages applied for 15 to 20 minutes, washed off, and reapplied if needful.
Spirituous essence of mustard injected hypodermically.
Salines in drinking water relieve fever.
Aconite, a few doses early in robust subjects, where symptoms acute.
Ammonium acetate solution, ipecacuanha, and squills while membrane dry and congested.
Benzoic acid, eucalyptus oil, terebene, pilocarpine, mineral acids diminish excessive secretion.
Soap liniment and laudanum rubbed into throat and down neck twice daily relieves difficult breathing, especially when secretion excessive.
Belladonna stimulates respiratory centre and eases cough, often conjoined with camphor, ether, chloral hydrate, and in debilitated patients small repeated doses of alcohol.
Electuaries or gargles of opium, chloral hydrate, with glycerin, relieve cough.
Pot. chlorate and amm. chloride promote fluid secretion and moderate its amount.

BRONCHITIS, ACUTE—*continued.*

Lobelia and opium where there is much discharge and paroxysms of cough.
Ammonium carbonate when mucus abundant and viscid and patient low.
Mash diet; regulate bowels, if possible, by enemata; cathartics dangerous in horses.
For dogs, emetic in early stage; ipecacuanha and antimonial wines where membrane dry and congested and fever high; in weakly subjects and advanced stages, bronchi cleared by emesis produced by ipecacuanha, squill, and ammonium carbonate.

BRONCHITIS, CHRONIC.

Equable temperature; pure fresh air; comfortable clothing, which must be removed, and patient wisped over night and morning.
Salines, with or without mercurials, relieve congestion and fever.
Terebene and eucalyptus oil, as stimulants of bronchial secretion.
Belladonna, balsams, and mineral acids diminish excessive secretion.
Ammonium carbonate and chloride useful where secretion viscid and irritating.
Belladonna and ether stimulate respiratory and cardiac centres.
Chloroform, chloral, and opium abate cough.
Mustard and other counter-irritants, carefully used, lessen congestion, irritation, and cough.
Mustard embrocation, although most effectual in early stages, also useful in chronic cases.
Soap liniment, with or without laudanum, frequently relieves cough.
Alcohol, ether, volatile oils, digitalis, maintain heart-action in weakly subjects.
Sulphurous acid, creasote, eucalyptus, and other antiseptics inhaled or internally when secretions fœtid.
Arsenic occasionally relieves emphysema.
Careful dietary; nutritive oleaginous food; linseed oil.
Iron and other tonics promote convalescence.

BRONCHOCELE.

Enlarged thyroid.
Local stimulation; iodine; pot. iodide.
Liberal dietary; full proportion of fatty matters.

BRUISES.

Foment, poultice, water-dressing, refrigerants, carbolic and other antiseptics. Massage, inunction with oil subsequently promote absorption.
Lead, zinc, and other astringent solutions probably prevent leucocytes exuding and accumulating outside vessels.
Belladonna, opium, aconite paralyse sensory nerves and relieve pain.

BRUSHING OR INTERFERING.

Occurs in horses with faulty action, especially when leg weary or out of condition.
Careful shoeing. A three-quarter shoe, or a shoe thin on inside web, without heel on outside.
Well-fitting boot on fetlock liable to be struck.
Improved condition often the most effectual remedy.

BURNS AND SCALDS.

Protect immediately from air and irritants by layers of cotton-wool, or application of carron oil.
Liniment of oil and litharge, with 5 per cent. boric, salicylic or carbolic acid, or peppermint oil.
Whiting and water, or Fuller's earth, applied, about consistence of cream, repeatedly, until tolerable coating formed.
Zinc oxide, with about 10 parts vaselin, or of glycerin and water.
Alkaline solutions, soap lather, saturated solution sodium bicarbonate relieve irritation in slighter cases.

CANCER—*continued.*

Generous diet retards exhaustion caused by absorption of disintegrated tissues.
Anodynes applied for relief of pain.
Antiseptic and deodorant dressings.

CANKER OF HORSE'S FOOT.

A fungoid disease affecting the secreting frog and sole of horses of the heavier breeds.
Milder cases benefited by removing superfluous horn, and using cleanliness, astringents, antiseptics, and moderate pressure.
A radical cure only effected by casting the horse, stripping off the sole, and cutting away all fungous growths.
A tourniquet applied to the fetlock prevents bleeding.
Professor Williams recommends dressing the whole exposed surfaces with silver nitrate, packing with dry tow, bandaging, and protecting with leather boot.
Dressings two days later soaked with warm water for an hour, carefully removed, any morbid spots cautiously touched with chromic acid, zinc chloride solution, or sulphuric acid and tar.
In persistent cases, caustics and astringents must be frequently changed.
Pressure must be applied as required ; scrupulous cleanliness essential.
Tonics and salines internally ; liberal diet.

CANKER OF EAR. See OTORRHŒA.

CAPPED HOCK IN HORSE.

(*a*) A serous abscess in the areolar tissue, immediately underneath the skin.
(*b*) Swelling of bursa of gastroenemius tendon.
Capped Knee—Distension of bursa of extensor metacarpi magnus.
Capped Elbow—Subcutaneous infiltration from bruising.
Hot fomentations ; subsequently stimulate by cantharides liniment or mercuric iodide ointment ; soft soap rubbed in daily.
Equable pressure sometimes applied by truss.
Evacuate serous abscess ; inject cavity with iodine or astringents.
In bursal form of capped hock use shoe raised at heel.

CARIES OF BONE.

Molecular disintegration and absorption of bone.
Excise diseased tissue ; provide exit for discharges.
Sulphuric or phosphoric acid diluted ; dress antiseptically.
Administer calcium phosphates.

CATARACT.

Opacity of the lens or of its capsule.
Extraction by operation.
Mydriatics—belladonna or atropine—for diagnosis operation, and alternated with physostygmine for obtaining free movement of iris.
Phosphoretted oil, instilled into human eye, if borne, leads to absorption.

CATARRH.

Cold in head ; Coryza ; Inflammation of mucous membrane lining nasal chambers and upper portions of respiratory organs.
House comfortably ; clothe body and head ; bandage legs.
Equable temperature of 60° to 65° F.
Steam head with vapour of water alone, or medicated with antiseptics or anodynes.
Warm or vapour bath ; patient quickly dried and re-clothed.
Mash diet or green food ; laxative enemata ; laxatives if required.
Amm. acetate solution ; pot. nitrate or chlorate ; other saline electuaries.
Hot fomentations ; stimulating embrocations to throat.

CATARRH, CHRONIC.

Isolate patient ; rest or gentle work ; if coat rough, clip or singe.
Arsenic, iron, copaiba, terebene improve general condition.
Inhalation or spray of sulphurous or carbolic acid or iodoform.
Astringent nasal douche or spray ; blister over nasal sinuses.

CEREBRO-SPINAL MENINGITIS.

Cerebro-spinal fever : A specific equine fever, characterised by hyperæmia and inflammation of the cerebro-spinal nervous centres ; more frequent in America than Great Britain.

Slings essential where patients cannot stand.
Full dose of aloes ; salines ; laxative clysters ; mash diet.
Where prostration marked, small repeated doses alcohol and quinine.
Counter-irritation to spine : ammonia and soap liniments ; ice-bag to spine.
Where urine not freely passed use catheter.
Chloral-hydrate and atropine, hypodermically, relieve spasms and pain.
Ergotin and atropine, hypodermically, approved by Mr Lyman, Boston, U.S.A., and Professor Williams.
Iron salts and strychnine relieve paresis remaining as sequalæ.

CHOKING.

Repeated doses linseed gruel or oil.
Remove, if possible, foreign body by hand ; manipulation over gullet.
Carefully introduce probang, cup end first.
Other means failing, cut into gullet and extract obstruction.

COLIC.

Gripes ; Spasm of intestines ; Irregular inordinate contractions of muscular walls of intestines ; in horse of two kinds—(*a*) spasmodic ; (*b*) flatulent.

Purgative to remove irritant : in horse, aloes ; in cattle and sheep, oils and salines ; in dog, castor oil.
Catharsis hastened and pain relieved by copious laxative clysters, hot fomentations, friction to abdomen, and gentle exercise.
Ether ; oil of turpentine, other volatile oils, ammonia and ammonium carbonate combat flatulence.
Ether, alcohol, and chloral hydrate, conjoined with opium, belladonna, or cannabis indica, control spasms and pain.
Morphine and atropine, hypodermically, promptly relieve spasm.
Inhalation of chloroform quiets violent spasmodic cases.
Repeated recurring attacks in influenza in horses, often connected with hepatic derangement, treated with half dose of aloes and a little calomel, spirit of chloroform, and mustard embrocation to abdomen.
Tobacco smoke clysters sometimes useful.
In intractable cases of flatulent colic in horse, colon may be punctured by suitable trocar and canula.

CHOREA.

Irregular convulsive movements of voluntary muscles dependent apparently on localised sclerosis of spinal cord (Reports of Brown Institute).
In horse most common in the form of stringhalt, which see.
In dog often as sequel of distemper.

Remove gastro-intestinal derangement, worms, or other cause of reflex irritability.
In weakly dogs or convalescents from distemper, generous diet, fair proportion of good milk or other fatty matters.
Iron salts, arsenic, other tonics, ether and spirits of camphor. Fellows' syrup.
Sponging or affusion with water, at first tepid, subsequently cold.
Violent spasms relieved by full doses chloral hydrate internally, or chloroform inhalation.
Counter-irritants over spine in long-standing cases.

Corns in Foot of Horse.
Bruise of secreting sole.
Remove shoe, pare to relieve pressure and ensure exit of any pus.
Poultices soften sole and abate tenderness.
Use light shoe with wide web.
Shoe strong feet with tips.

Cough.
Violent expulsion of air from lungs.
Comfortable housing and clothing, pure air, careful feeding, oleaginous diet.
Catarrhal.—Steam head; ammonium acetate solution; salines; ether; mustard to throat.
Bronchial.—Ammonium acetate; ipecacuanha; squills; nitrous ether; counter-irritants.
Dry, with scant secretion.—Amm. acetate or chloride; pot. bicarbonate and chlorate; borax.
With profuse discharges.—Balsams; eucalyptus oil; tar; terebene; creasote; astringent sprays or inhalations.
Irritable.—Demulcents; camphor and belladonna; conium; opium; hydrocyanic acid; cocaine.
Reflex.—Bromides; chloral hydrate; remove cause of irritation.

Cough, Chronic, of Horses.
Careful dieting; food damped; linseed mash or oil.
If coat long, clip or singe.
Epsom salt, or other salines, occasionally.
Professor Dick's recipe.
Belladonna; camphor; alcohol; tar; creasote; arsenic.
Counter-irritants: mustard, mercuric iodide ointment, setons.

Crib-Biting.
Iron stable-fittings.
Manger when unused turned into recess in wall.
Use muzzle or spiked neck strap; concentrated digestible food.
Chalk, antacids, and occasional laxative relieve the indigestion from which crib-biter usually suffers.
Crib-biter should be placed by himself, as other horses imitate and acquire the habit.

Croup.
Cynanche trachealis; Inflammation of upper air passages with formation of membranous exudate; occurs in young calves.
Inhalation of steam, medicated with chloroform, creolin, sanitas or creasote.
Spray with iodine, iodoform, carbolic acid, silver nitrate.
Laxatives; antiseptics internally.
Tracheotomy when breathing difficult.

Curb.
Sprain or injury of straight ligament of hock.
Foment; lead acetate solution; refrigerants.
Counter-irritants; mercuric iodide ointment; charges; firing-iron.
High-heeled shoe, no toe-pieces.
Rest, especially in young horses, must extend for several months.

Cow-pox. See Variola Vaccina.

Cystitis.
Inflammation of urinary bladder.
Oleaginous laxatives, aconite, calomel and opium abate fever.
Blood letting, followed by above sedatives, in early stages, where there is acute pain, distress, and fever.
Belladonna, internally in clyster, and suppository in vagina, allay irritation.

Diarrhœa.

Scouring; Frequent discharge of loose fæces.
Laxatives in first stage to remove irritant.
Perfect rest; keep patient comfortably warm.
Restrict water; diet carefully; wheaten flour gruel.
Alkalies; chalk where dejections acid.
Mineral acids or gallic acid with opium in profuse serous discharges.
Enemata of starch gruel at 100° F., with lead acetate and opium.
Aromatics and camphor abate nervous irritability.
Oil of cinnamon valuable in cases resulting from cold.
Volatile oils, ether, chloroform, chlorodyne in moderate frequently repeated doses relieve flatulence and spasm.
Ammonium carbonate where watery secretions continued, and heart action weak.
Arsenic and opium in chronic cases.
Copper sulphate; corrosive sublimate with creosote and opium when chronic discharges contain mucus and blood.
Ergotin and opium administered with keratin where discharges profuse and continued.
Antiseptics, sulphites, sulpho-carbolates where discharges foul.
Nitric acid and nux vomica when complicated with hepatic derangement.
In young animals, castor oil with a few drops laudanum.
While patient fed on milk, if it disagrees, while given with lime water in cautiously regulated restricted amount, substitute cooked starch food, or beef tea and white of egg, with a little wine or spirit if animal reduced.
Grey powder in young patients, where discharge is pale and foul smelling.

Diphtheria.

A specific fever characterised by inflammation of throat, accompanied by exudation and softening of mucous surfaces; contagious; occasionally affecting horses and dogs.
Ice sucked abates tenderness and swelling.
Ferric chloride tincture, locally and internally.
Spray with chlorine, iodine, iodoform solutions.
Electuaries of boroglycerin, or glycerin of carbolic acid.
Sodium sulphites and hyposulphites, and sulpho-carbolates locally and internally.
Belladonna electuaries relieve congestive stage.
Salicylic acid and pilocarpine aid in dissolving false membrane.
Soft nutritive food, eggs, beef tea, alcohol sustain strength.

Dislocations.

Luxations; not common in the lower animals.
Bring bones into natural position.
Retain in position if needful by splints, bandages, plasters; sling if necessary.
Abate inflammation by hot fomentations or cold water.

Distemper in Dogs.

A specific contagious catarrhal fever.
A mild laxative and emetic in first stage empty the bowels and relieve fever.
Restrict to digestible simple food, mainly milk diet.
Good nursing more important than medicine; keep animal clean and comfortable.
Catarrhal symptoms abated by ammonium acetate solution and ipecacuanha; steaming and sponging nose and eyes.
Sodium hyposulphite, grs. ij. to grs. vi., daily, recommended by Professor Williams.
Belladonna, locally and internally, and stimulant embrocations externally relieve dry congested swollen throat.

DISTEMPER IN DOGS—*continued.*

After four or five days, quinine, beef tea, white of egg, and wine sustain weakly patients.

Hydrocyanic acid and chlorodyne check gastric irritation and vomiting.

Antiseptics locally and internally when discharges fœtid.

Nervous complications. See CHOREA and EPILEPSY.

If eyes become affected treat as in OPHTHALMIA.

Prevent spread by early isolation and use of disinfectants.

DROPSIES.

Serous effusions.

Endeavour to restore function of heart, kidneys, or other organs, the impaired actions of which cause the effusion ; Turkish baths.

Digitalis infusion and strychnine useful in most dropsies, especially in cardiac, in which given with salines.

Copaiba in cardiac and hepatic cases.

Laxatives and pot. iodide in renal dropsies.

Encourage vicarious functions of bowels and skin if kidneys affected.

Iron and salines in cases associated with anæmia.

Restrict quantity of fluid ; friction ; shampooing ; external stimulants.

Trocar and canula ; aspirator ; acupuncture.

DYSENTERY.

Bloody flux ; Inflammation and ulceration of mucous membrane and glandular structures of intestines. Occurs in all the domestic animals.

Easily digested emollient food ; water supply restricted ; perfect quiet.

Small occasional doses grey powder or calomel, with other antiseptics, help to maintain a septic state of bowels.

Occasional dose of castor oil and laudanum needed when patient feverish.

Lead acetate and opium, gallic, tannic, or mineral acids, with opium or carbolised glycerin and opium in solution, or bolus encased in keratin.

Chloroform, chlorodyne with opium, relieve tenesmus.

Opium as anodyne, by mouth enema and suppository.

DYSPEPSIA.

Indigestion.

Careful dietary ; avoid long fasts ; vary food ; allow water at reasonable intervals, or allow constant supply in stable.

A laxative almost invariably the first requisite.

Conjoined with cholagogue in bilious cases.

Alkalies, chalk, magnesia, given before feeding, or with food in atonic cases.

Ball of whiting and piece of rock salt in horse's rack.

With alkalies may be conjoined nux vomica and other bitters.

Hydrochloric or other mineral acids with bitters and iron salts, more permanently effectual than alkalies in persistent cases.

Hard-worked horses often benefited by mixing an ounce linseed oil with food daily.

Glycerin useful, especially in young animals.

Ox-bile, with gentian or nux vomica, used by Professor Robertson in intractable cases in horses.

Bismuth and hydrocyanic acid in chronic gastric irritability.

Creasote, eucalyptus, peppermint oils where undue fermentation present.

Arsenic with morphine in chronic irritable cases, and where food excites diarrhœa.

DYSPNŒA.

Difficult breathing.

Discover and, if possible, remove cause.

Fresh air. Chloroform, inhaled or swallowed.

Chloral hydrate, in spray or draught.

DYSPNŒA—*continued.*

Belladonna extract and ether.
Amyl-nitrite ; nitro-glycerin in angina pectoris.
Counter-irritants if due to congestion or inflam. of air-passages.
Tracheotomy where obstruction occurs in upper air-passages.

ECTHYMA.

American skin disease ; Eruption of papules and rather large pustules.
Laxative salines remove gastro-intestinal or other irritants.
Exercise further hastens removal of waste products.
Digestible, rather laxative, dietary.
Mineral acids, iron salts, bitters, arsenic, act as antiseptics and alteratives.
Pustules treated by water dressing, boric acid, zinc oxide ointment.
Sometimes contagious ; hence patients should be isolated and disinfection adopted.

ECZEMA.

Cutaneous catarrh. Eruption of minute crowded vesicles, which, as the fluid they contain is absorbed, form flakes or scales ; non-contagious.
Four varieties or stages occur in horses and most other animals (Professor Robertson).

Eczema, Simplex.—Humid tetter; localised, with little general disturbance.
Pot. carbonate, diluted solution, or saturated sol. pot. bicarbonate.
Boro-glycerin, borax, and vaselin soothe and hasten healing.
When depending upon gastro-intestinal derangement give dose of physic succeeded by diuretics.
Laxative cooling diet.
Keep the animal, if possible, from biting and rubbing himself.
Clip all long hair in this and other eczemas.
As vesicles dry apply zinc oxide and kaolin alternated with tar oil.
Where discharges profuse and skin puffy astringents best applied dry ; zinc oxide being mixed with 6 or 8 parts kaolin or starch, or surfaces dusted with bismuth ternitrate.

Eczema, Rubrum.—More inflammatory, extended, and with more exudation.
Constitutes red mange of dogs.
Thorough cleansing with soft soap and water.
Free repeated soaking with mercurous oxide wash.
Subsequent dressing with zinc oxide ointment.
Lead acetate with glycerin and water relieves inflammatory weeping stages.
Stronger lead lotions with chloroform or laudanum, or both, relieve dry and itching surfaces.
Where inflammatory spots limited, paint with two grains silver nitrate in ounce of water, or of water and glycerin.
Laxatives and salines, cooling diet while skin hot and tender and patient feverish.
When febrile symptoms abated, administer mineral acids, bitters, tonics ; linseed in herbivora ; in dogs, avoid oatmeal and heating animal food, and give cod-liver oil.
Carbolic and mercurial dressings dangerous for dogs (Professor Williams).
Mercuric nitrate ointment applied in eczema of eyelids.
Boro-glycerin or hydronaphthol for eczema labialis or facialis.

Eczema Impetigenodes or Pustulosum.—Inflammation more deeply involving skin textures and glands, and with free pus formation as in grease in horses.
Mercurous oxide wash ; zinc or lead acetate solutions, aqueous or oleaginous.
Occasional dressings of eucalyptol or thymol abate suppuration and itching.
Opium and belladonna tinctures conjoined with astringents relieve irritation and pain.

EPIZOOTICS.

Disease attacking large numbers of animals in a short space of time and spreading widely; generally contagious.

Endeavour to destroy disease germs by carbolic acid, chlorine, sulphurous acid gas, or other disinfectants.

Isolate infected subjects.

Sponge sick and healthy with sulphurous or carbolic solutions.

Administer sodium sulphite, sulpho-carbolates, or other antiseptics.

Enjoin cleanliness.

ERYSIPELAS.

A specific febrile disorder, characterised by diffuse inflammation of the skin and subjacent tissues, and the presence of the streptoccus erysipelatous; occurring in horses, sometimes as an epizootic.

Aperients usually abate irritation.

A few doses aconite relieve acute febrile symptoms.

Salines, pot. chlorate conjoined with spirit of camphor.

Hot fomentations persevered with for several hours, and affected surfaces subsequently moistened with borax solution and laudanum.

Subcutaneous injection of antiseptics sometimes limits swellings.

Belladonna, both internally and locally, paralyses sensory nerves.

Abscesses should be opened, but scarification of phlegmonous swellings is rarely justifiable.

Cleanliness, good sanitary surroundings, generous diet essential.

Milk and eggs, beef tea, alcoholic stimulants help to sustain strength.

Ferric-chloride solution, both externally and locally, especially in weakly patients, for whom also prescribe quinine.

ERYTHEMA.

Patches of superficial dermal inflammation, with effusion into the epidermis. *Mud Fever* in horses a common variety.

Laxatives, especially when connected with gastro-intestinal irritation.

Salines in drinking water; pot. bicarbonate.

Cleanse thoroughly. Glycerin and water, zinc or lead salts in sol. externally.

Zinc oxide with kaolin or starch, in exudative forms, in which moisture to be avoided.

Where horses are liable to mud fever, the hair should not be removed from their legs, and washing should be forbidden.

Chronic forms, such as occur in cracked heels in horses, painted over with silver nitrate, 1 part to 12 water; or where this fails, blisters, diuretics, and liquor arsenicalis internally.

Arsenic and quinine internally in persistent cases.

EXOSTOSIS.

Deposit of bone.

Fomentations or refrigerants allay inflammation and pain of early stages.

Counter-irritants where heat and tenderness have been removed.

Mercuric iodide ointment; firing-iron; setons; periosteotomy.

Plugs moistened with irritant placed under skin over exostosis.

Laxatives, with iodine and pot. iodide internally, promote absorption.

FAINTING.

Syncope. Results from enfeebled action of heart.

Fresh air; remove any pressure from neck.

If horse down do not attempt to raise him.

Raise blood-pressure by draught of cold water.

Ammonia inhaled, swallowed, or injected hypodermically.

Alcohol and ether, swallowed or in enema, especially when heart action weak or fluttering.

False Quarter.

Fissures in wall of horse's foot, from injury of secreting coronary band.
Endeavour to restore secretory function of coronary band.
Dress and promote healing of any wounds in band, pressure will generally be applied, and dead horn trimmed away.
Apply bar shoe to relieve concussion; prevent dirt getting into cracks by filling them up with gutta-percha.
Blisters to coronet sometimes useful.

Farcy.

A variety of glanders, caused by a bacillus, occurring in horse, ass, and mule. Produced in man and other animals by innoculation, exhibiting cutaneous or subcutaneous nodules, which ulcerate and develop secondary infection of the lymphatic glands.
Dress buds with mercuric iodide ointment or stick of silver nitrate.
Sodium hyposulphite; iron and copper sulphates; arsenic internally.
Liberal diet; exercise desirable, except in acute cases.
Isolate from healthy animals, and use disinfectants.
All treatment only palliative; farcy subjects should be slaughtered as enjoined under Contagious Diseases (Animals) Act.

Favus.

Honeycomb-Ringworm, produced by the epiphyte Achorion Schönleinii. Occurs in man, horses, cattle, dogs, and cats, but not so common as the tenea variety.
Alkalies; soft soap and warm water, with bland oil, soften and remove scabs.
As parasiticides—iodine solution or ointment; sulphur iodide; mercurial and corrosive sublimate ointments; ferric-chloride solution; thymol; creasote.
In weakly subjects give internally mineral acids, bitters, tonics.

Fever, Acute or Inflammatory.

Concurring with acute local inflammation.
Aconite, occasionally blood letting, in earlier stages in robust subjects.
Aperients; salines; laxative enemata.
Attend to wounds; remove any causes of irritation.
Warm clothing, but cool air to breathe.
Warm bath, or sponging with warm water.
Sodium sulphite, sulpho-carbolates, resorcin, or other antiseptics and antipyretics.
Alcohol and digitalis sustain cardiac tone.
Salicylic acid and salicin in rheumatic fever.
Acids and bitters allay thirst and aid digestion.
Light, easily digested food; diluents; salines in drinking water.

Fever, Low or Typhoid.

Occurs in most epizootics in connection with septicæmia and pyæmia, in inflammation of mucous membranes, and in debilitated subjects.
Mild laxatives and enemata when required.
Salines; acids; bitters; antiseptics.
Quinine, especially in intermittent types.
Arsenic in malarial cases.
Alcohol, ethers, or volatile oils promote excretion and maintain heart action.
Turpentine and iron salts, indicated in hæmorrhagic cases.
Suitable clothing; diet; hygiene; sponging; baths.

Fever, Simple.

Continued fever; Febricula; occurring independently of local inflammation or septicæmia; common among horses brought into dealers' stables.
Comfortable box; plenty fresh air and light; perfect quiet.

FEVER, SIMPLE—*continued.*
Clothe body; bandage legs; mild laxative.
Salines; ammonium acetate solution; pot. chlorate or nitrate; spirit nitrous ether.
Mash diet; gruel; diluents; withhold hard, dry food.
Alcohol; ether; bitters; acids; tonics so soon as acute symptoms abate.
Catarrhal, gastro-intestinal, or other special symptoms receive appropriate treatment.

FISTULA.
A sinus with more than one opening. A narrow suppurating canal.
Open sinuses with knife; pass seton, or otherwise provide dependent opening.
Remove diseased texture or other irritant.
Encourage healing of wound from below.
Where knife unsuitable, inject saturated solution of corrosive sublimate, or sulphate of copper or of zinc.
Where milder treatment fails, slough out ulcerating surfaces and secreting walls with corrosive sublimate or arsenic plug.
Dress with carbolic or other antiseptic.

FLATULENCE. See INDIGESTION and HOVEN.

FLEAS.
Pulex irritans.
Soap and warm water; cleanliness of skin and surroundings.
Turpentine, aniseed, or other volatile oils.
Persian insect powder; stavesacre decoction; tobacco water.
Pine sawdust for dog's bed.

FLUKEWORM IN SHEEP. See HYDATID IN LIVER—under WORMS.

FLYBLOW.
Affecting wounds; specially troublesome in sheep.
Corrosive sublimate solution; turpentines; tar oil.

FOOT-ROT IN SHEEP.
Inflammation and ulceration affecting various structures of foot of sheep; frequently contagious.
(*a*) Abrasion of horn; inflammation of secreting surfaces of sole or walls, beginning below and extending upwards.
(*b*) Inflammation of interdigital structures, with burrowing of discharges under the horn of inner walls of digits, beginning above and extending downwards. This the more contagious variety.
Remove diseased horn and any irritating foreign bodies.
Dress affected parts with mercuric nitrate solution, zinc chloride, carbolic acid, tar oils, or silver nitrate, the strength of the dressings being regulated according to circumstances.
Over dressing gutta-percha varnish may sometimes be usefully applied.
Walk sheep through wooden trough containing 1 lb. each arsenic and sodium carbonate, and 50 gallons water, or 1 part copper sulphate to 50 parts water (Professor Williams).
While feeding sheep have foot-rot, avoid beans and other forcing food.
Transfer infected flock, if possible, to dry upland pastures.

FOUL IN FEET OF CATTLE. See BUSTIAN FOUL.

FOUNDER. See LAMINITIS.

FRACTURES.
Broken bones.
Bones brought into apposition.
Splints of leather, lath, block-tin, paroplastic, or gutta-percha.
Encase in plaster of Paris; starch bandages.
Ends of bones may be kept together by metallic sutures.

FRACTURES—*continued.*

Smart blister causes outpouring of fibrinous, plastic, reparative material, also favours parts being kept at rest.
Larger animals may require to be slung.
Wounds in compound fractures treated antiseptically.
Calcium phosphate internally in weakly subjects hastens union.

FRAGILLITAS OR MOLLITIES OSSIUM.

Bone softening, somewhat resembling osteo-porosis, which see.
Liberal oleaginous dietary; calcium phosphate; tonics.

FROST-BITE.

Gelatio.
Raise temperature of frozen parts gradually.
Stimulants to affected parts; turpentine and oil; soap liniment.
Treat sloughs antiseptically.

FUNGUS HÆMATODES.

Vascular sarcomatous growth, usually protruding from orbit; more common in cattle and sheep than horse.
Extirpation of eyeball.
Speedy feeding and slaughter of patient.

GANGRENE.

Mortification. Death and decomposition of a part usually accompanied by presence of micro-organisms.
Remove textures already dead by knife or silver nitrate, chromic or carbolic acid, iodoform or bromine.
With silver nitrate or other caustic endeavour to limit extension of gangrene.
Maintain wounds aseptic.
Stimulate circulation in surrounding parts.
Sustain general strength by generous diet; tonics and stimulants.
Administer sulphites and other antiseptics.

GAPES IN FOWLS.

Caused by Strongulus syngamus. See WORMS.

GARGET. See MAMMITIS.

GASTRITIS.

Inflammation of stomach. Rare in adult horse except from action of irritants, but not uncommon in badly-fed foals and calves, in older cattle as abomasitis, and occasionally in dogs.
Oily laxative removes any irritant and irritant discharges.
Ice, with hydrocyanic acid or morphine, or morphine hypodermically, relieve irritation and pain.
Antacids and bismuth, with or without small doses opium, most useful in young animals and dogs.
Hot fomentations to abdomen.
The brain symptoms and paralysis often occurring in adult cattle usually relieved by full doses of oil followed by demulcents, treacle, salines, and laxative enemata.
Patients nourished with milk, eggs, well boiled gruel, and nutritive enemas.

GLANDERS IN HORSES.

A specific contagious malignant disease of the horse, ass, and mule, depending upon a bacillus, specially affecting the air-passages and lymphatic system, and transmissible to man and many other animals. Occurs in a more localised chronic form as FARCY, which see.
Incurable. Under Contagious Diseases (Animals) Act, glandered subjects must be immediately reported and slaughtered.

GLANDULAR SWELLINGS.
Counter-irritants around or near; iodine; mercury oleate.
Mercuric iodide.
Salines, iodine, and iodides internally.
Calcium chloride and sulphide internally help maturing of indolent swellings.
Iron salts in anæmic patients.
Inject with carbolic acid, hydronaphthol, or other antiseptic.

GLASS EYE. See AMAUROSIS.

GLAUCOMA.
Disease of vitreous humour of eye.
Not amenable to treatment; iridectomy affords relief.
Physostygmine diminishes intraocular pressure.

GLOSSANTHRAX. See ANTHRAX.

GLOSSITIS.
Inflammation of the tongue.
Irrigate with mild astringent solutions.
Apply bismuth, oxymel, treacle, and vinegar.
Furnish soft nutritive food.
Scarify if œdema extensive.

GRAPES.
Inflammation, œdema, and hypertrophy of the papillary structures of the skin of horses' heels.
Remove by hot iron or caustics.
Dress with solution of zinc sulphate or chloride or carbolic acid.
Laxative diet; exercise or suitable work.
Iron salts; arsenic; iodine; salines internally.

GREASE.
Erysipelatous impetigo; Inflammation of the cutaneous glands (seborrhœa) and tissues, with increased and perverted secretion. See ECZEMA.
Thoroughly wash with soft or carbolic soap and warm water.
Laxatives; diuretics; salines; green food.
Rough hair should be trimmed away, and an antiseptic bran poultice applied where there is much inflammation and discharge.
Removal of scabs also helped by soaking with salicylic acid in solution of borax.
Zinc sulphate, acetate, sulpho-carbolate or chloride lotions, 3 parts to 100 water, with 2 parts each carbolic acid and glycerin.
Vary dressing with sulphur iodide, wood tar oils, carbolic acid or copper sulphate.
Sulphuric acid and iron salts, iodine, arsenic, internally.

GROGGINESS. See NAVICULAR DISEASE.

GROUSE DISEASE.
Probably depends upon a rod-shaped microbe which has been found by Dr Klein in the viscera of infected birds.
In order to limit production and distribution of microbe, diseased birds should be destroyed and burned with all found dead.

HÆMATURIA.
Bloody urine from injury or disease of urinary organs.
Oleaginous laxatives; sulphuric acid; iron salts; lead acetate internally.
Ergotin and belladonna hypodermically.
Fresh sheep skins to loins of horse; spinal hot-water bag.

HÆMOGLOBINURIA.

Azoturia. The pathology of this disease is still unexplained. The urine, although its spec. grav. is unaffected, is albuminous and high coloured from suspended granular pigment, possibly derived from the voluntary muscles, which are suddenly affected by spasm, and subsequently become pale, flaccid, and wasted; while both the muscles and various internal organs contain after death a crystalline pigment. The disease invariably *occurs in horses which have been rested for a day or two.*—(Professor J. M'Fadyean, *The Journal of Comparative Pathology*, March 1888).

Dose of physic; action seconded by laxative enemata.

Chloral hydrate and opium, or nitrous ether and turpentine, are the most approved prescriptions.

Ammonia and turpentine liniments are frequently applied over the loins.

Frequently repeated moderate doses of alcohol, ether, or spirit of ammonia, with sulphuric acid and quinine, combat tendency to cardiac failure.

Where urine is not regularly passed, use catheter thrice daily.

Attacks prevented by regular work or exercise, and sloppy unstimulating food when resting.

Red or black water in cattle, occasionally in sheep; enzootic; occurring after parturition; probably depending on a bacterium.

Change of diet; restrict supply of roots.

Saline purge; stomachics and bitters.

Iron salts; turpentine; ammonium chloride.

HÆMOPTYSIS.

Bleeding from the lungs.

Abundance of fresh air and where lungs congested friction to skin, embrocation to legs, which subsequently envelop in woollen bandages.

Ice to swallow.

Alcoholic stimulants, repeated every hour or oftener, to restore balance of circulation.

Gallic acid; oil of turpentine; iron perchloride; ergot solutions in persistent cases.

Ergotin hypodermically.

Digitalis where heart action weak or irregular.

In dogs and small animals, moisten chest externally with chloroform.

HÆMORRHAGE.

Bleeding.

Bleeding from superficial wounds, when only small veins are lacerated, usually arrested by pressure, application of cold water, ice, refrigerants, or styptics.

A bleeding artery, as in castration, sealed by touch of hot iron, by torsion, or ligature; sometimes by severing a partially cut artery.

Bleeding which cannot be got at, arrested by cold or heat applied so as to act reflexly; by administration of such styptics as lead acetate, and opium, sulphuric or gallic acids, or ferric chloride; or by hypodermic injection of ergotin.

HÆMORRHAGE, POST PARTUM.

Promote uterine contraction by removal of placenta and introduction of ice into uterus or rectum, or both.

Contraction also produced by injection of water at about 110° F.

Also by packing uterus with antiseptic tow or cotton wool.

Injection into uterus of ferric chloride, or ergot solutions, or ether spray.

Ergotin hypodermically.

Raise hind-quarters; hot water-bag to dorsal region.

Alcoholic stimulants with laudanum ward off collapse.

Heart, Dilated.

Usually accompanied by compensatory hypertrophy.

Avoid over-exertion; digestible, rather concentrated, nutritive diet.

Digitalis, iron salts, or morphine, as indicated by special conditions.

As with most cardiac diseases, treatment only palliative.

Heart, Fatty.

Common in pampered dogs, and in horses that have suffered from serious or repeated attacks of reducing disease.

No over-exertion; careful dietary.

Iron salts; arsenic; strychnine.

Heart, Hypertrophied.

Occurs in hard-worked aged horses.

Aconite and digitalis, in small doses, if heart action violent.

Moderate, slow work.

Heart, Palpitation.

Rest, perfect quiet, generous diet; iron tonics where there are anæmic murmurs.

Aconite, small doses, where cardiac action violent.

Digitalis where action weak and irregular.

Bromides sometimes useful where action irregular and fluttering.

Laxatives when connected with digestive derangement.

Belladonna where condition associated with strain or over-exertion.

Strychnine acts as heart tonic.

Heart, Valvular Disease.

Treatment only palliative.

Aconite, cautiously used, may quiet inordinate action.

Digitalis most useful in mitral disease.

Purgatives, nitrites, and arsenic lower vascular tension.

Morphine relieves dyspnœa and pain.

Hepatitis.

Inflammation of the liver.

Cathartic, salines, amm. chloride; aconite if febrile symptoms prominent.

Ipecacuanha valuable, especially in dogs.

Fomentation and stimulation over region of liver.

Digestible, laxative diet; suitable exercise when acute symptoms relieved.

Nitro-hydrochloric acid in chronic cases.

Salines and careful dietary safer than more active remedies when hepatic inflammation or congestion associated with epizootic or other debilitating disease.

Hernia.

Protrusion of organ from natural cavity.

Umbilical.—Exomphalos, chiefly occurs in young animals.

Patient, after fasting for several hours, must be cast, placed on back, and protruded portion of intestine returned.

Retained in position by sutures, clamps of wood or iron, skewers, or elastic ligature.

Cantharides blister, or other irritant, applied to adjacent skin, causes swelling, and in slighter cases occludes opening.

Ventral.—Protrusion of abdominal viscera through rupture in abdominal wall, usually through staking or thrust of a horn.

Unless large, or liable to strangulation, seldom causes inconvenience.

Where small and recent, opening usually closed by a blister.

Radical cure effected by returning viscus, and cutting down and suturing opening in abdominal walls.

Inguinal and Scrotal.—Although occurring in entire horse, extremely rare in gelding.

HERNIA—*continued.*

Cast, and return the bowel by taxis, and if need be by application of ice or refrigerants.

If this fails, enlarge constricting ring.

Covered castration operation in entire animal.

HERPES.

(*a*) Eruption of rather large vesicles in irregular patches about junction of skin and mucous membrane, associated with gastric derangement, occurring in young animals.

(*b*) Irregularly distributed patches of papules, vesicles, or pustules, affecting adult animals; probably not contagious (Professor Robertson).

An alkaline wash, with subsequent inunction with vaselin.

Boro-glycerin, with a drop of hydrocyanic acid, relieves itching.

Half a dose physic or salines remove the gastric derangement on which most cases depend.

Occurring in foals or other young animals feeding on milk, see to health of mother and state of milk.

The spreading variety persisting often for several weeks, probably depending on a parasite, is treated by diluted solution of iodine or other antiseptic.

The more inflammatory and pustular variety of adult horses is treated by half a dose of physic, the vesicles and pustules dressed with zinc oxide, or boric acid; itching abated by menthol.

Growth of hair when thinned or destroyed promoted by mild cantharides or other stimulant.

HOOSE IN CALVES—caused by Strongulus micrurus. See WORMS.

HOVEN IN CATTLE OR SHEEP.

Distension of first stomach, chiefly with gas.

A full dose of ammonia, ether, turpentine, alcohol, or chloroform in solution.

Exercise and friction to abdomen hasten expulsion of gas.

Introduction of hollow probang allows escape of gas when amount of food in stomach is limited.

In extreme cases, puncture abdominal walls with trocar and canula; or where these are not at hand, with butcher's, carving, or other large knife.

Administer cathartic to remove any irritant, and feed for several days on sloppy, digestible food.

When rumen is distended with food—

A smart purge is conjoined with an active stimulant, but repeated purgatives are injurious.

Solid food is interdicted; slops, treacle and water, and ginger freely given.

Water containing salines is offered at short intervals.

Nux vomica useful when viscus in atonic state.

When distension and distress increase, there should be no delay in emptying the engorged stomach by rumenotomy.

HYDATID IN BRAIN OF SHEEP OR CATTLE.

Cœnurus cerebralis; Larvæ of tapeworm.

Trephine; remove by trocar and canula.

Prevent by effectual treatment of all dogs with tapeworm, and see that dogs do not get brains of sheep affected with hydatid.

HYDROCELE.

Dropsy of scrotum, rare in veterinary patients.

Evacuate by trocar and canula.

Injection of iodine or other astringent solution.

HYDROCEPHALUS.
Dropsy of brain; occurs in young animals, associated with tuberculosis.
Perfect quiet; pot. iodide to promote absorption; bromides if there is much excitability.
Mild stimulation by application of iodoform ointment to head.
Generous oleaginous diet; calcium phosphate; iron salts.
Trephine to relieve pressure in extreme cases.

HYDROPHOBIA. See RABIES.

HYDROTHORAX.
Fluid in the chest.
Digitalis; powdered cantharides; pot. nitrate twice daily for a week.
Follow up with pot. iodide and iron salts.
Pilocarpine useful in human patients.
Iodine ointment and rubefacients externally; or insert under skin of chest plug of tow anointed with irritant.
When such measures ineffectual, where water fills one pleura, or half of each, where for three weeks no diminution of fluid noted, or where dyspnœa increases, tap with trocar and canula, or pneumatic aspirator.

IMMOBILITÉ.
Crick-back. See SHIVERER.

IMPETIGO.
Pustular dermatitis. Pustular eczema. Occasionally contagious.
Laxatives; salines; pot. chlorate.
Zinc oxide or mercuric nitrate ointments.
Glycerin of tannin; borax and camphor with glycerin.

INDIGESTION. See DYSPEPSIA.

INDIGESTION, ACUTE, OF HORSES.
Stomach or grass staggers.
Aloes or calomel and oil to unload stomach and bowels.
Ether or spirit of ammonia, every two hours, overcomes flatulence and spasm.
Repeated copious laxative enemata, and vigorous hand-rubbing of abdomen and walking exercise, encourage action of bowels and relieve spasm.
Hot fomentations or cloths wrung out of hot water, or in-rubbing of merely warming dose of mustard, abate spasm and pain.
Where pain persists, morphine and atropine hypodermically.
One or two small doses of aconite tincture sometimes useful.
Blood letting is sometimes advisable where brain disturbance or dyspnœa occur.
A long, fine trocar and canula may be used in extreme cases where tympanitis become dangerous.
Paralysis resulting, use strychnine and counter-irritants to spine.
In young animals, where stomach overloaded with clots of curd, prescribe oil, followed by ether or spirit of ammonia.

INFLAMMATION, ACUTE.
Aconite, small doses in early stages repeated three or four times until pulse and temperature reduced.
Blood letting in first stage in robust patients, especially where serous membranes sharply attacked.
Calomel and other mercurials useful in human patients, especially when serous and fibrous membranes are affected; but are seldom so serviceable in veterinary subjects.
Place patient in suitable quarters; ensure cool, pure air.
Clothe body, bandage legs.
Hot fomentations or poultices most useful where inflammation is comparatively superficial.

INFLAMMATION, ACUTE—*continued.*

Mustard or other stimulant embrocations applied to warm skin withou blistering.

Ice or refrigerants applicable where inflammation limited or superficial, and in pharyngitis and laryngitis.

Cathartics to open bowels, and lower arterial tension and temperature.

When more acute symptoms relieved, salines in small repeated doses—pot. nitrate and chlorate, magnesium sulphate, ammonium salts, sodium sulphite.

Simple digestible diet; diluents.

Cannabis indica, opium, belladonna; other anodynes internally and topically.

Provide for removal of morbid products by maintaining activity of excretory channels.

Belladonna and salicylic acid, salicylicates, alkalies, and salines, in rheumatic and cystic inflammations.

INFLAMMATION, CHRONIC.

Secure removal of morbid products by keeping excreting channels, unless themselves inflamed, in good working order by clothing, suitable diet, diluents, occasional laxatives.

Salines and antiseptics. See INFLAMMATION, ACUTE.

Where patient reduced, give digestible nutritive food.

Bitters, acids, and alcohol promote appetite.

Alcohol and volatile oils most useful in worn-out town horses, or where blood poisoning has occurred.

Iodine and pot. iodide liquify and remove exudate.

Counter-irritants frequently valuable—mercury oleate, embrocations, mustard occasionally applied and washed off.

Hypodermic injection of Savary's liquid mustard.

When joints or bones affected, mercuric iodide ointment, seton, or firing.

Opium belladonna, other anodynes topically.

Ice and cold applications occasionally answer better than hot.

INFLUENZA.

Contagious febrile epizootic, chiefly affecting various portions of the respiratory tract of horses.

(*a*) Horse distemper. Catarrhal influenza, or epizootic. Pferdestaupe. Severe cases constitute pink-eye. Very infectious. Seldom occurs more than once in same animal.

(*b*) Chest plague. Infectious pleuro-pneumonia. According to degree of virulence, croupous or gangrenous pneumonia, with secondary pleurisy, and parenchymatous degeneration of principal organs.

(*c*) German authorities further describe an infectious sub-acute diffuse bronchitis, termed Scalma, and an ephemeral infectious pneumonia, probably caused by some special stable miasma (Professor M'Fadyean, *The Journal of Comparative Pathology*, June 1889).

Isolate patient and use disinfectants.

Comfortable box; temperature 60° to 65° F.; pure air.

Rugs, hood, bandages to legs.

Maintain bowels in regular state with enemata, linseed mashes, and if need be, with occasional laxative.

Febrile symptoms combated with liquor amm. acetatis, Epsom salt, and nitre.

Restrict to mash diet, with a little green food, but when febrile symptoms abate, give digestible concentrated nutritive food.

Catarrhal symptoms treated by steaming head, medicated inhalations, or sprays. See CATARRH.

Flannels wrung out of hot water, and mustard, or other embrocations, to throat, relieve congestion of upper air passages.

JAUNDICE—*continued*.
Prescribe nitro-hydrochloric acid; where patient weak conjoin quinine with the acid.
Little relief can be given in jaundice depending upon scirrhosis or fatty degeneration.

KENNEL LAMENESS. See RHEUMATISM.

LAMINITIS.
Acute Founder. Inflammation of sensitive laminæ of horses' feet.
Shoes removed; horn thinned; bed box with several inches chaff or cut straw.
Continued hot fomentations or poultices soften horn and relieve tension and pain.
Cold bran poultices over entire foot sometimes afford more relief than hot.
Bleed from jugular or toe in acute cases.
Bleeding more suitable when attacks result from concussion than from gastric derangement.
Repeated small doses of aconite, nitre, and other salines relieve fever.
Bowels, if need be, regulated by half dose physic and laxative enemata.
Vapour bath frequently serviceable.
When inflammation is subdued, removal of exudate is hastened by cold applications, and later by blisters to coronet, occasionally by frog setons.
Keep heels low and toe short, and use stout wide-webbed and long bar shoes.
Neurotomy sometimes subsequently useful where lameness persistent.

LAMPAS.
Congestion of gums and palate of horses from teething and gastric derangement.
Soft food, astringent wash.
Scarify when swelling excessive and painful.

LARYNGITIS.
Inflammation of larynx; usually also involving pharynx.
Comfortable box, clothing, protect from draughts, moist atmosphere of 60° to 70° F.
Steam head and throat persistently with medicated vapour; heat and moisture externally.
Aconite and laxatives abate fever in early stages of acute attacks.
Emetics relieve fever and dyspnœa in dogs and pigs.
Ammonia acetate solution, camphor and belladonna electuary.
Benzoin, sulphurous acid, iodine, or chloroform as inhalation, spray, or electuary.
Salicylic acid and pot. chlorate, as electuary, every hour where œdema great.
Counter-irritants: soap and opium liniment, mustard, cantharides.
Tracheotomy where dyspnœa becomes dangerous.

LARYNGITIS, CHRONIC.
Alum, ferric chloride, sulpho-carbolates, or tannic acid, as electuary or spray.
Belladonna and camphor, with glycerin and water, as anodyne gargle.
Thickening of the mucous membrane, treated by pot. iodide and counter-irritants.
Essence of mustard hypodermically.
Ulceration of the rima glottidis dressed with silver nitrate.

LEUCORRHŒA.
Fluor Albus. The Whites. Inconstant muco-purulent discharge from the uterus. Occurs in all domestic animals.
Syphon or syringe the uterus and vagina with tepid alkaline solutions, and subsequently with dilute carbolic acid or zinc sulphate.

LEUCORRHŒA—*continued.*

Belladonna or iodoform in suppository, or injection where there is excessive secretion or pain.

Copper or iron salts, turpentine internally, especially in delicate subjects, or in obstinate recurring cases associated with tuberculosis.

Common cause of vaginitis and abortion, also of balanitis in male having connection with affected female.

LICE.

Pediculi; Phthiriasis.

Two, sometimes three, species infest the domestic animals; development aided by damp dirt and use of barley straw.

Cleanse skin with soft soap and warm water, and rub in decoction of stavesacre or tobacco—1 part insecticide, 40 water.

Oil of tar, 1 part; oil of rape or other bland oil, 4 parts.

Oil of tar, 5 parts; liquor amm. fort., 1 part; water, 50 parts.

Equal parts carbolic acid and soft soap, 10 of oil.

Sulphur iodide ointment; mercuric nitrate ointment; use cautiously for isolated, thickly-infested spots.

Patients long infested require to be dressed entirely over, the application being well rubbed in, especially where the hair is long.

Clipping long, coarse hair facilitates cure.

For small dogs, apply diluted solution of chloroform and essential oil.

Isolate infested subjects and their belongings, and thoroughly cleanse premises occupied by them.

LICHEN.

Chronic eruption of non-suppurating papules, which produce abundance of bran-like scales.

Laxatives; salines; oleaginous diet.

In chronic cases, tonics and arsenic.

Apply locally, night and morning, an alkaline wash, to which—if there is itching—add a little chloroform or prussic acid.

Iodide of sulphur ointment, thymol, and tar oils are alternated in chronic cases. See PRURIGO.

LITHIASIS: GRAVEL. See CALCULI and URINARY DEPOSITS.

LOCKJAW. See TETANUS.

LOUPING ILL IN SHEEP.

Trembling: A nervous disorder of sheep, occasionally of cattle, characterised by convulsive movements, and exhibiting some increase of fluid in the spinal cord, but no notable lesions.

Cure uncertain.

Prevention ensured by securing flock sufficient suitable food and pure water.

Improve moor and other poor pastures on which disease occurs.

LUXATIONS. See DISLOCATIONS.

LYMPHANGITIS.

Weed: Monday morning disease; Inflammatory œdema; Inflammation of lymphatic glands, absorbent, and blood-vessels of horse's limb—usually the hind limb.

Bleed from jugular in robust subjects, and where fever is acute.

Dose of physic, laxative enemata, and salines in drinking water remove irritant waste products. Bran mashes and wet food.

Aconite serviceable where fever acute.

Hot fomentations persisted with for several hours, and limb then lightly swathed in woollen or hay bandages.

Where limb tender and painful after fomenting, moisten with soap liniment and laudanum.

When weather cold, clothing needful to promote skin functions.

LYMPHANGITIS—*continued.*

Stimulants useful where preliminary rigor severe or continued.

Exercise is injurious while acute symptoms continue, but is serviceable later.

In hard-worked, debilitated subjects, bleeding and aconite unsuitable.

Give half dose physic and salines, foment limb, and administer turpentine and alcoholic stimulants.

Aid removal of swelling by exercise, and subsequently moderate work; smart friction of limb daily, with oil; diuretics and tonics; iodine or pot. iodide internally; laxative diet and green food.

Careful regulation of food, work, and rest, attention to diet, and exercise of susceptible subjects diminish chances of recurrence.

LYMPHATICS, INFLAMED.

Especially in horses, from wounds and pricks.

Remove original cause.

Cooling diet; salines; pot. iodide.

Foment while heat and tenderness continue.

When tenderness abates, apply friction, bandages, iodine ointment; continue salines in drinking water.

MAD STAGGERS. See PHRENITIS.

MALADIE DU COÏT.

A specific equine constitutional disease, characterised by lesions of the urino-genital organs, and communicable from coition by either affected horse or mare.

Mucilaginous and anodyne vaginal injections allay, in the earlier stages, irritation in the mare.

Followed by astringent injections of zinc or copper sulphates or silver nitrate.

The horse, cast and secured, should be treated with similar astringents.

The blood being very deficient in fibrin, French veterinarians prescribe bouillon of cattle blood and horse flesh; crushed oats and beans should also be serviceable.

Many months often elapse before cure is effected.

In Prussia no affected stallion can again be used in the stud until three years after recovery is reported.

MAGGOTS, FROM FLYBLOW.

Turpentine and oil; corrosive sublimate solution.

MALLENDERS and SALLENDERS. Forms of PSORIASIS, which see. Situated in the flexures of horse's knee and hock.

Soft soap and water, bland oils and bran poultices, remove scales.

Boro-glycerin or zinc oxide ointment for relieving irritation.

Mercuric nitrate or iodine ointments useful where there is thickening and infiltration.

Tar oils suitable in chronic cases.

Half dose physic, salines; laxative diet essential.

In debilitated subjects iron tonics and arsenic.

MALNUTRITION.

Liberal oleaginous dietary; change of food.

Acids and bitters; iron salts; calcium phosphate in young animals.

Alcohol; arsenic; nux vomica.

MAMMITIS.

Garget. Inflammation of the udder. Most frequent in good dairy cows.

Cathartic; antipyretics in drinking water.

Bleed from jugular, and give a few doses of aconite where fever acute and patient in high condition.

In cold weather clothe to promote skin functions.

MAMMITIS—*continued.*

Milk three or four times daily, or oftener; and with careful pressure remove drippings and deposits which ferment and increase irritation. Support udder.

Introduction of teat syphon sometimes facilitates removal of milk, but it must be used very carefully.

Apply heat and moisture by persistent fomentations, or poultices of spent hops, supported by wide web of sacking round the body.

Belladonna extract and vaselin applied several times daily lessens congestion, milk secretion, and tenderness.

When inflammation acute and extensive, inject atropine into udder.

When inflammation abates, removal of exudate encouraged by in-rubbing of iodine ointment, and iodine and salines internally.

When abscess forms, it must when ready be opened and treated antiseptically.

When gangrene occurs, dead tissues must be excised and wounds dressed with antiseptics.

After earlier pyrexia removed, the cow's strength must be sustained by concentrated good food, tonics, and stimulants.

Until udder again in normal state, restrict to dry food, so that production of milk be minimised.

MANGE.

Scabies. See ACARI. Skin irritation and itching produced by several species of acari.

(*a*) The Psoroptes or dermatodectes, affecting the body.

(*b*) The Sarcoptes, also affecting the body, and burrowing into the skin.

(*c*) The Chorioptes or Symbiotes, affecting the limbs and producing parasitic eczema or grease.

The first and third varieties are most frequent in horses and cattle; all three varieties occur in sheep, but the first is most common. The Sarcoptes canis is the cause of mange in the dog, which also harbours the Demodox folliculorum, which inhabits the sebaceous and hair follicles, and is also found on human patients.

Isolate infected subjects.

Thoroughly cleanse, wash, and disinfect with carbolic or corrosive sublimate solution clothing, harness, stable fittings, rubbing-posts.

Crusts must be softened and removed by soap and water, oil, vaselin, or glycerin and water.

The parasite must be destroyed without causing undue skin irritation, by stavesacre ointment or solution, sulphur iodide ointment, or mercuric nitrate ointment.

Tar oil 1 part, palm oil 6 parts, also good and cheap.

Every itching spot must be thoroughly dressed, and the dressing undisturbed for three or four days, when it is washed off and re-applied a week later to any spots again itching.

Grooming or combing the patient should meanwhile be prevented, on account of scattering the parasites.

Scabies depending on the burrowing Sarcoptes requires that the parts affected be thoroughly washed with soap and water, soaked for some hours with solution of pot. carbonate and oil, and the parasiticide then rubbed in. To ensure destruction of spores, a second dressing is desirable a week later.

Washing with lead acetate solution relieves any eczema frequently accompanying mange.

Diluted alkaline solutions and oil of eucalyptus abate psoriasis.

Chronic inflammatory sequelæ are treated by weak solutions of Goulard's lotion, glycerin and water, with salines, arsenic, and iron salts internally.

MANGE—*continued.*

Extension of the disease prevented by isolation of infected subjects, and disinfection of everything on which the parasites or their spores can have lodged.

Pine sawdust should be scattered on dog's bed.

Treatment of scab in sheep specially noticed (p. 695).

MEGRIMS.

Vertigo: Giddiness; occurring in horses; consisting in cerebral congestion, usually resulting from pressure of the collar, sometimes from reflex irritation.

Remove pressure interfering with cerebral circulation.

Dash cold water over head and neck.

Walking exercise; hand-rubbing of body and legs.

Moderate bleeding, or dose of physic sometimes useful.

Horses subject to megrims should be driven with breast-strap.

MELANOSIS.

A species of Sarcoma, found both general and localised.

Remove by knife or caustic.

Dress with antiseptics.

MENINGITIS.

Inflammation of the membranes of the brain and spinal cord.

(*a*) Cerebral; (*b*) Spinal—frequently extending to subjacent nervous textures. Occurs in all veterinary patients, frequent and fatal in cattle and sheep, in which usually associated with gastric derangement. See PHRENITIS and LOUPING ILL.

An active cathartic, repeated if needful about the third day.

Blood-letting where delirium occurs in robust subjects.

Perfect quiet; restrict to mash diet and diluents; use catheter if urine not passed.

Dark box, and cold applications to head in cerebral cases.

Hypodermic injection of bromides and cannabis indica relieve excitement and pain.

When acute symptoms abated, pot. iodide and salines useful.

Paralysis remaining treated by nux vomica, and blisters to poll or spine.

The epizootic form among horses noticed as cerebro-spinal meningitis, which see.

METRITIS.

Inflammation, usually of a septic character, affecting the membranes of the uterus; sometimes also extending to the peritoneum; common in cows and ewes. Liable to spread by contagion.

Syphon or syringe out uterus with tepid water and antiseptic.

Remove any portion of placenta or blood clots; render aseptic any wounds.

Where walls of uterus dilated or flaccid, inject solution of ergot and belladonna tincture.

Rugs wrung out of hot water, applied over loins and round abdomen, relieve spasms and pain.

As in other septic cases, sulpho-carbolates, sulphites, hydronaphthol are given internally.

If bowels are torpid, give half dose physic with ginger, gentian, and treacle, and promote effect by laxative enemata.

Remove urine by catheter.

Sustain strength by generous diet, tonics, and stimulants.

Isolate patients from gravid or parturient animals, and use disinfectants.

MORTIFICATION. See GANGRENE.

MUD FEVER. See ERYTHEMA.

MURRAIN.

Foot and mouth disease. See APHTHOUS EPIZOOTIC.

MYOSITIS.
Inflammation of muscle.
Rest, especially when resulting from direct violence or over-exertion.
Injured muscles should if possible be kept relaxed.
Fomentation succeeded by application of belladonna or opium liniments.
Cathartic and salines, especially when dependent upon rheumatic or other blood poisoning.
Counter-irritation, galvanism, regular exercise, when atrophy supervenes.

NASAL GLEET.
Ozœna.
Sulphurous acid, iodine, iodoform inhalations.
Nasal douches of salt and water containing a few drops of iodine tincture.
Bleaching powder scattered in box.
Copper or iron sulphates, arsenic, turpentine, buchu, and copaiba, internally.
Blister over sinuses; remove faulty teeth.
When other treatment fails, trephine sinuses, and after removing as much pus as possible, wash out with antiseptics.
Isolate all horses with suspicious nasal discharges.

NAVICULAR DISEASE.
Grogginess. Rarifying ostitis of the navicular bone of the horse, with necrosis of the articular cartilages and surrounding structures; the tendon of the flexor pedis perforans is subsequently inflamed, and becomes adherent to the navicular bone. Concussion and rheumatoid diathesis are believed to be the chief causes.
Remove shoes and allow frog to come to the ground.
Stand horse in cold water baths, or apply cold wet swabs for several hours daily.
Apply at night, poultice, but not too unwieldy or preventing patient lying down.
Dose of physic and cooling diet.
After fortnight or three weeks, lightly blister coronet.
If marked benefit does not result, seton frog, and keep seton in three or four weeks.
If disease still persists, relegate horse to slow work with shoes without heels or toe piece, or try neurotomy.
Concussion diminished by shoeing with leather, and using shoes thick in quarters and thin at toe and heels.

NECROSIS.
Death of bone.
Remove sequestrum; antiseptic dressings.
Encourage reparative process by local and general treatment.

NETTLE RASH.
Surfeit. See URTICARIA.

NEPHRITIS.
Inflammation of the kidneys.
Blood-letting if febrile symptoms acute.
Aconite in early stages of acute cases.
Gentle laxatives remove waste products and hence lessen work of kidneys.
In suppression of urine, Professor Williams orders digitalis decoction repeatedly applied to the loins.
Linseed; diluents; barley water. Promote skin functions.
Alkaline bicarbonates, alkaline sulphites render urine aseptic.
Anodyne clysters relieve reflexly.
Fomentations or fresh sheep skins to the loins of horses.
Where chronic irritation remains, belladonna, opium, and camphor given as anodynes.

Neuralgia.

Pain along course of nerve.

Endeavour to discover and remove any cause of nerve irritation.

Any wound likely to cause or aggravate should be fomented and dressed antiseptically.

Half dose physic promotes action of bowels and excretory channels.

Chloroform, belladonna, opium or cannabis indica liniments.

Chloroform, atropine, morphine hypodermically along course of nerve.

Administer salines, iodine with pot. iodide, arsenic, phosphorus; pot. bromide where patient irritable.

Counter-irritants, mustard, iodoform, veratrine, electricity in chronic cases.

Nerve stretching worthy of trial.

Iron salts, strychnine internally.

Generous diet, with fair proportion of oleaginous matters, where patient debilitated.

Œstrus Equi. See Bots.

Open Joints.

Healing by first intention promoted by cleansing wound and antiseptic dressing.

Severed surfaces brought together by suture, provided movement of joint and tearing can be prevented.

Styptic colloid, collodion, or plaster, applied for support and protection.

Splints and bandages further secure apposition of lips of wound and perfect rest of parts.

Slinging horse prevents movements which might re-open wound, and removes weight which in injuries of limbs aggravates inflammation.

Inflammation relieved by half dose of physic; cooling diet, and weak antiseptic solution allowed continuously to trickle over a calico bandage lightly laid over the joint.

When the wound is unlikely to close quickly, or simple treatment has failed, a blister is applied, which usually closes the opening, limits motion, and relieves pain.

Anchylosis apt to result where injury has been serious or case neglected or badly treated.

Ophthalmia.

(*a*) *Periodic or Specific;* Moon blindness: Specific inflammation of most of the structures of the eye of the horse; hereditary; frequently associated with rheumatic diathesis, liable to recur, and eventually causing cataract and blindness.

Incurable; relieved by cathartics, febrifuges, anodynes, belladonna, or atropine, locally and internally.

(*b*) *Simple inflammation of the eye,* occurring in all animals.

Remove any foreign body.

The membrana nictitans has sometimes to be first secured with a tenaculum or stitch.

Fomentation with tepid water and decoction of poppy-heads abates irritation, whether depending on foreign body or cold. Half dose physic.

Where inflammation severe, blood may be drawn from the angular vein.

Silver nitrate and other astringent solutions applicable in chronic cases.

Belladonna and atropine, locally and generally, diminish irritation and prevent adhesion of iris.

Steam head when concurring with œdema of lids, as in influenza attacks.

Protect the eyes from light.

Orchitis and Epididymitis.

Inflammation of the testicles and epididymis.

Fomentations; anodynes; dose of physic; support testicle.

Iodine liniment; pot. iodide internally.

Tubercular form intractable; castrate in early stage.

OSTEOMA.

Cancellous bony tumours; affecting the jaws of cattle.
Remove in early stages.
When of rapid growth are frequently malignant, and termed osteo-sarcoma. Many are actmomycos.
Patient should be promptly fed for slaughter.

OSTEOPOROSIS.

Consists of the excessive development of the tissues which occupy the canals and cells of the bones, whilst at the same time the actual quantity of bony matter remains unaltered (Rokitansky). From perverted nutrition the bones are thus swollen, softened, and brittle. The cartilaginous tissues, and even the teeth, undergo similar degeneration. The disease occurs in horses, cattle, and sheep.
Curative treatment has been of no avail.
Prevention consists in furnishing food containing fitting proportion of all the elements of nutrition.

OSTITIS.

Inflammation of bone; usually associated with periostitis; occurring in splints, ringbone, sore shins, and of a tuberculous type in bustian foul.
Heat and moisture; cold applications; allow escape of any exudate.
Cooling diet; salines; alteratives.
Blister; seton; fire.

OTORRHŒA.

Inflammation of lining membrane of ear. Occurs in dogs.
Hot fomentations continued for several hours.
Laudanum and lead acetate solution dropped into ear.
Glycerin of tannin and other mild astringents.
Morphine hypodermically.
Cathartic; cooling diet.
When complicated with ostitis, give febrifuges and insert seton behind ear.

OVER-REACH.

Bruise of coronet of fore-limb of horse, caused by the shoe of the hind-foot.
Foment; antiseptic dressing.
Protect coronet with pad.
Use light shoes; shorten and round off offending shoe.

PARALYSIS.

Paresis; Palsy; Loss of motor power; (1) General; (2) Unilateral or Hemiphlegia; (3) Transverse or Paraphlegia; (4) Local. The fourth variety most common.
Pot. iodide and salines if dependent on pressure from fluid.
Trephine, and raise bone if results from depression of cranial bones.
When caused by embolism or thrombosis, treat as there under.
Remove any gastric, uterine, or other local irritation, or blood contamination.
Rest; quiet; light digestible food.
When bladder affected, remove urine by catheter.
Salines, tonics, and other remedies improve general vigour.
Nux vomica and strychnine stimulate motor centres and nerves.
Friction, kneading, and occasional application of counter-irritants and electricity impart nervous and muscular tone.
In cattle, paresis when depending on gastric derangement treated by full dose of physic and subsequent nerve tonics.
As a sequel of milk fever, pot. iodide followed by nux vomica, and counter-irritants to spine.
Connected with anæmia, liberal dietary and tonics.
In dogs, after dose of castor oil, prescribe pot. iodide, and if stomach irritable, give hydrocyanic acid.

PATELLA, DISLOCATION OF.

After replacement, keep limb extended for several hours by a cord attached to the fetlock and carried round the neck.

Put on a shoe high at the toe and projecting forward.

Blister the stifle.

PERICARDITIS.

Inflammation of serous covering of heart.

Cautious blood-letting followed by small doses of aconite serviceable in acute idiopathic cases, but unsuitable in second stages or in epizootic attacks.

Morphine hypodermically usually relieves acute pain.

Woollen cloths wrung out of hot water applied to the chest for an hour or two at a time.

Soap liniment containing one-twentieth part opium tincture rubbed in freely between each fomentation.

Sodium bicarbonate, and sulphate in drinking water, relieve fever and maintain action of bowels.

Digitalis may be used carefully when heart action feeble and rapid.

In more advanced stage and when fluid effused, supporting treatment needful; moderate doses of stimulants; pot. or ferrous iodide with mustard or cantharides to chest.

Digitalis and strychnine assist absorption of fluid by raising blood pressure in renal arteries, and promoting diuresis.

Where hydrops pericardi persists, the fluid may be removed by special trocar and canula.

PERITONITIS.

Inflammation of serous membrane covering the bowels and lining the abdominal walls.

Blood-letting and a few doses of aconite may occasionally be given in early stages of acute cases, in robust subjects, when unconnected with epizootic attacks.

Full doses of opium are given to quiet movement of bowels and relieve pain.

Morphine and atropine hypodermically most prompt and effectual.

Woollen rugs wrung out of hot water applied for two hours continuously and surface then rubbed with soap liniment and opium tincture.

A light dressing of mustard applied for 15 to 20 minutes useful, but active counter-irritation injurious.

Milk, eggs, beef-tea, and oatmeal gruel support strength.

When more acute symptoms past, salines in drinking water and enemata maintain natural condition of bowels.

Alcoholic or etherous stimulants and camphor useful in the second stages and in young and weakly subjects, and earlier in most cases associated with influenza.

A cantharides blister where unabsorbed fluid remains in the peritoneal cavity.

PHLEBITIS.

Inflammation of vein.

Apply cantharides blister along course of vein.

Open any abscesses; cathartic laxative diet.

Horse with impervious jugular should not be turned to grass.

Diffuse phlebitis treated antiseptically with salines internally.

PHRENITIS.

Cerebritis; Mad staggers of herbivora; Inflammation of the brain, usually also affecting the membranes. Not common in veterinary patients.

Bleeding where symptoms urgent.

Cathartics and laxative enemata.

PLEURO-PNEUMONIA EPIZOOTIC—*continued.*

proliferation results, the peri-bronchial lymphatics are implicated and blocked, fibrinous lymph fills the air-cells, inducing catarrhal bronchitis and hæmorrhagic infarctions, and the pleura becomes similarly involved.

Treatment generally unsatisfactory.

Aconite tincture and salines abate febrile symptoms.

Laxatives, mash diet, and linseed tea relieve indigestion.

Solid food, as in most cases where rumination suspended, should be interdicted or given very sparingly.

When rumination re-established, ordinary diet only gradually resumed.

Concentrated digestible food and stimulants prescribed when patients debilitated.

Prevention.—Under Contagious Diseases (Animals) Act, cattle affected, and those that have been in contact with them, must be immediately slaughtered.

Slightly affected subjects in good condition are passed for beef, other carcases, disinfected, used for manure.

Premises in which disease has appeared should be thoroughly cleansed and disinfected, and for at least three months no cattle should be placed in them, or in fields where diseased animals have grazed.

Where pleuro occurs in a district, the utmost caution to be observed in purchasing fresh stock.

Uninfected cattle innoculated with serum taken from lungs in early stage of pleuro are protected against the disease.

PNEUMONIA.

Inflammation of lungs.

Box of equable temperature, about 65° to 70° F.

Clothe body, bandage legs; feed herbivora on cold linseed tea, steamed food, and fresh grass.

Blood-letting may be adopted in acute attacks with urgent symptoms in robust patients.

A few small doses aconite tincture where pyrexia acute.

If fever of low type, as it usually is in hard-worked town horses, sulphuric or nitrous ethers with camphor and amm. carbonate, are prescribed in draught; while amm. acetate, pot. chlorate, and nitrate are given in draught or drinking water.

Pot. nitrate and colchicum prescribed by Professor Williams when kidneys not acting.

Rugs wrung out of hot water applied to sides, subsequently warmed with rubefacient dressing.

Alcoholic stimulants, ether, nitrous ether, spirit of chloroform, several times daily when deliquescence of exudate has commenced, or earlier in epizootic attacks or in weakly patients.

Belladonna extract and camphor allay cough.

Linseed oil in mash, neutral salts in drinking water, with laxative enemata, secure regularity of bowels.

If laxative absolutely needful, oil preferable to aloes.

Emetic and antimonials in earlier stages in dogs and cats, followed by small repeated doses chloral hydrate.

Cooling mash diet in earlier stages; in later, digestible nutritive food.

POLL EVIL. See FISTULA.

POLYURIA. See DIABETES INSIPIDUS.

PRICKS IN HORSES' FEET.

Remove shoe, search for injury.

Remove diseased tissue and any pus.

Provide dependent opening; poultice; dress antiseptically.

Prolapsus of the Rectum or Uterus.

Return viscus carefully, after cleaning and washing with dilute spirit, laudanum, and a little carbolic acid.

Close external opening with truss or suture.

Control straining by opium or chloral.

When rectum much swollen scarify carefully.

When uterus prolapsed and swollen, it should be enveloped in a towel, the ends of which are crossed and traction exerted; the bulk of the viscus can thus be lessened and its return much facilitated.

Prostatis.

Inflammation and abscess of prostate gland. Occurs in dogs.

Difficult of treatment. Catheter usually needful to remove urine.

Pot. iodide internally; iodine ointment externally promotes absorption.

Belladonna and eucalyptus oil internally abate irritation, which is also relieved by fomentation and belladonna applied locally.

Prurigo.

Inflammation and exudation into the papillary and rete layers of the skin, with eruption of papules, varying in size and causing much itching.

Half dose physic, salines, and cooling digestible diet, relieve gastric derangement and remove waste products.

Mineral acids; bitters; tonics; Donovan's solution serviceable in weakly subjects.

Itching relieved by pot. bicarbonate with glycerin and water; corrosive sublimate, 1 part to 500 of water; silver nitrate, 1 part to 250 of water; pot. cyanide, 1 part to 150 of water; spirit of chloroform, 1 part to 50 of water.

Sulphur iodide and wood tar oils are alternated night and morning, when the skin in chronic cases is much thickened.

Pruritus.

Itching. Regarded by some authorities as identical with Prurigo, by Professor Robertson as a cutaneous neurosis, occurring independently of eruption or inflammation, and attacking both horses and dogs.

When resulting from exposure to sun heat, the animal is brought into the shade and washed over with pot. bicarbonate, and any specially irritable spots subsequently moistened with a lotion made with 2 parts glycerin, 1 each of sugar of lead and laudanum, and 60 of water.

Hydrocyanic acid, pot. cyanide or chloroform, alternated with alkaline washes, abate increased sensibility.

Corrosive sublimate, thymol, or other volatile oils, locally when itching depends upon parasites.

Cathartics, salines, careful dietary, when associated with gastric derangement.

Iron salts, oleaginous food, alkalies, arsenic, internally when patients impoverished.

Psoæ Muscles Strain.

Rugs wrung out of hot water applied over loins and round abdomen.

Anodyne enemata.

Slings essential when both sides affected.

Psoriasis.

Hypertrophy of papillary layer of skin, chiefly about the flexures of joints, associated with a chronic eruption of slightly elevated rather dusky patches, covered by adhering scales, and in chronic cases intersected by cracks and fissures. Mallenders is the variety most common in horses.

Washing with soap and alkaline solutions; inunction with vaselin and bland oils remove scales.

PSORIASIS—*continued.*

Iodine, sulphur iodide, calomel, mercury or mercuric nitrate ointments, diminish thickening and arrest fibroid changes in the corium.

These ointments alternated, in chronic cases, with wood tar oils—oil of cade very useful.

Laxatives, salines, green and oleaginous food, and an occasional diuretic, aid cure.

Alkalies, sulphites, phosphorus, arsenic, internally, help to control the abnormal conditions.

A triple compound of arsenic, iodine, and mercury, administered by Professor Williams.

PUERPERAL FEVERS IN CATTLE. See APOPLEXY, PARTURIENT, AND METRITIS.

PUMICED FOOT IN HORSES.

Convexity and weakness of the sole, the result of laminitis.

Bar shoe with wide web.

Lessen concussion by tar dressing and leather soles.

Stimulate coronet.

PURPURA HÆMORRHAGICA.

A febrile disease affecting horses, characterised by extravasation of blood on the mucous membranes and skin, with infiltration of serum and feebly coagulable lymph into the skin and areolar tissues, and septic fever. Frequently a sequel of exhausting disease.

Pot. chlorate, three or four drachms two or three times daily, subsequently half doses; usually given in drinking water.

Iron salts, sulphate, perchloride; quinine, oil of turpentine.

Good hygienic conditions essential.

Concentrated nutritive diet; oatmeal gruel, milk, eggs, alcoholic stimulants.

Swellings when limited and about head, bathed with cold water and refrigerants.

About throat, body, and legs, hot fomentations preferable, especially in cold weather.

Scarification to be avoided unless swellings are large and causing much inconvenience.

Scrupulous cleanliness and antiseptic dressings essential while portions of skin ulcerating or sloughing.

Tracheotomy desirable where dyspnœa distressing.

PYÆMIA.

The multiplication and circulation of pyogenic organisms, causing formation of abscesses and hectic fever. It occasionally follows strangles in horses; arthritis and other diseases accompanied by suppuration in cattle, and distemper in dogs.

Any ulcerating, suppurating wounds whence infective pus may arise must be cleansed and rendered aseptic.

Sanitary conditions must be of the best.

The patient must be coaxed to take digestible nutritive concentrated food, in order to sustain strength and ward off collapse.

Moderate doses of alcoholic and etherous stimulants repeated every three or four hours.

Sulphites, hypo-sulphites, sulpho-carbolates, quinine, and other antiseptics internally.

Hydro-naphthol, a recently discovered antiseptic, about half the germicidal power of corrosive sublimate, but non-poisonous, should be tried.

Moderate stimulation of congested or swollen parts sometimes arrests further mischief.

Injection of iodine tincture or dilute carbolic acid into inflamed glands sometimes checks destructive suppuration.

Quarter Evil. See **Anthrax.**

Quittor.

The pipes. See also Fistula. A sinuous wound of the horse's coronet.

Secure free dependent opening.

Remove any dead tissues or other irritant and poultice.

Lay open sinuses and inject corrosive sublimate solution.

Where sinuses numerous and difficult of access, core them out with corrosive sublimate or arsenic plug.

Where foot strong no shoe needed; but if weak or broken, bar shoe relieves pressure.

In very bad cases diseased textures must be excised.

Blister coronet to promote reparative action.

Rabies.

A nervous febrile disease originating in the canine, occasionally in the feline race, produced by a specific microbe which is present in the saliva of the rabid animal, and which reproduces the disease when by bite or scratch it is introduced into the body of any warm-blooded animal. The disease thus caused in man is termed hydrophobia.

Under Contagious Diseases (Animals) Act, all dogs bitten or suspected to have been bitten by a rabid animal are destroyed.

Free cauterising of any superficial wound with caustic potash or silver nitrate, previously excising any lacerated tissues, greatly diminishes risk of the disease being produced in man or animal bitten by a mad dog.

M. Pasteur has demonstrated that dogs and other animals innoculated with cultivated virus do not take the disease when bitten by a rabid dog, or innoculated with virus which would kill unprotected animals.

This protective effect, M. Pasteur claims, may generally be secured if the bitten man or animal be innoculated with the protective virus shortly after being bitten.

When the disease is developed cure is hopeless.

Rheumatism.

Inflammation of the fibrous structures of muscles, tendons, and joints, liable to shift from one part to another; and believed to depend upon the accumulation in the body of some product of nutritive derangement, probably lactic acid.

Alkalies, pot. bicarbonate and nitrate in drinking water.

Amm. acetate and colchicum (Robertson).

Blood-letting believed to increase tendency to cardiac symptoms.

Hot fomentations, or flannels wrung out of hot water or oil, applied to affected parts.

Subsequently moisten with aconite, opium, or other anodynes.

When acute symptoms abated, quinine, arsenic, Donovan's solution internally.

Perfect quiet in comfortable quarters.

Stiffness or swelling subsequently removed by flannels soaked with hot oil and alkaline solutions, kept in position for an hour or two with lightly-fitting bandages; soap liniment subsequently rubbed in; such treatment will not prevent the horse doing light work.

If milder remedies fail, apply cantharides ointment either near or immediately over affected part.

The actual cautery sometimes required in chronic articular rheumatism.

Rickets.

Rachitis. Faulty development and softening of the bones of young animals depending upon some undefined constitutional fault.

Nourishing diet; milk, crushed oats with linseed for herbivora; milk, meat soup, cod-liver oil for dogs.

RICKETS—*continued.*

In young animals sucking, see that mother's milk sufficient in quantity and quality.

An aperient or antacids will rectify digestive derangement.

Calcium phosphate; Parrish's food; iron salts; healthy surroundings.

Splints and bandages may be requisite to support the softened bones.

RINDERPEST.

Cattle plague. A specific malignant contagious fever, affecting the bovine race, but communicable to sheep and other ruminants, depending upon a specific virus, and characterised by lesions chiefly localised in the skin and mucous membranes. Indigenous to the Asiatic Steppes of Russia and in other parts of Asia.

Treatment is ineffectual.

Slaughter of infected animals, and those they had cohabited with, and effectual disinfection promptly exterminated the disease imported into Great Britain in 1865, as well as the limited outbreak of 1872.

RING-BONE.

Exostosis resulting from stitis; situated (*a*) around the pastern joint, or (*b*) around the coffin joint; sometimes in both positions.

When occurring in the fore-limb, use a thin-heeled bar shoe; when in the hind-limb, a high-heeled shoe, thus diminishing pressure and concussion.

Put to slow work on soft land. When in stable, apply wet swabs.

Where there is lameness, rest, give dose physic and blister.

RINGWORM.

Circular elevated spots becoming scaly and itchy, appearing usually on the skin of the neck and body, produced by the epiphyte Tricophyton tonsurans which is transmissible from one species of animal to another.

Lead subacetate solution 1 part to 80 water freely applied.

Mercuric nitrate ointment; mercuric chloride solution; ferric chloride, copper sulphate solutions.

Iodine tincture, or carbolic acid glycerin and water.

Grooming or dressing of affected subjects should be interdicted, as it spreads the spores.

Soaking with oil softens and removes scales and scabs.

Salines, tonics, arsenic, internally, help to abate irritation and œdema.

Isolate affected animals, and disinfect all brushes, clothing, harness, or whatever the fungus may have lodged on.

ROARING.

May depend on thickening of the mucous lining of the nares pharynx or larynx, or on fibrous growths in these regions; but the majority of cases of roaring in horses consists in paralysis, wasting, and fatty degeneration of the whole of the intrinsic muscles of the left side of the larynx supplied by the recurrent nerve. The tube through which the air passes being narrowed, the characteristic noise is produced, especially when inspiration is quickened by excitement or exertion. Most roarers are wheezers and also grunters, and in the lighter breeds are whistlers.

Spurious roaring depending upon cold, strangles, or influenza, is treated sometimes successfully by stimulation of the throat, and by pot. iodide and arsenic internally.

True roaring depending on muscular wasting is incurable.

Smart blistering, the actual cautery, and galvanism in the earlier stages, sometimes retard atrophy.

Relegate the animal to slower work.

A pad fitted on the nostrils regulating the supply of air lessens the noise in bad cases.

Tracheotomy also affords relief.

Removal of the paralysed vocal cord is useless.

Removal of the aretenoid cartilage is seldom permanently effectual.

Rot in Sheep. See Worms. Distoma hepaticum.

Saddle Galls.

Bruises from badly fitting saddles or harness.

Relieve from weight and prevent friction.

Apply cold water and antiseptic dressings, hot water if suppurating.

Swollen sebaceous follicles in the early stages are reduced by friction with soap liniment; in chronic cases by fomenting and lancing.

Portions of dead tissue or exudate constituting **sitfasts**, when inflammation has been subdued, should be dissected out.

Sandcrack.

Fissure in horn of horse's foot, usually on inner quarter of fore-feet or toe of hind.

Remove shoe, bottom crack; clearing away dirt; allowing escape of any pus.

Fomentation, poultice, and rest relieve inflammation and pain.

Laxative when there is pain and much lameness.

When these abated, pare away upper part of cracked horn, cutting off connection with secreting coronary substance.

Put on bar shoe, made to relieve fissured horn from pressure and concussion.

When horse returns to work, plug crack with gutta-percha to prevent entrance of dirt.

Hold fissured surfaces together by clasp, or with nails driven on either side of the cracked crust, and around which wire is wound.

Stripping only adopted in extreme cases.

Sarcomatous Tumours

Are chiefly composed of embryonic or connective tissues; they contain blood-vessels, but neither nerves nor lymphatics have been clearly made out; they differ greatly in appearance, rapidity of growth, and malignancy, and occur in all the lower animals. Melanosis and actinomycosis belong to this group.

In the earlier stages, especially if likely to interfere with any important function, they may be removed by the knife.

Scab in Sheep.

Skin irritation caused by Scaroptes ovis. See Acari and Mange.

Careful thorough dressing of every itching spot with corrosive sublimate 1 part, common salt 8 parts, water 500 parts.

Decoction of tobacco 1 part, water 40 parts.

Stavesacre decoction (1 part to 40 water) with 20 parts of which, shake up when using, 1 part each of wood-tar oil and pot. carbonate.

In all bad cases the sheep should be bare shorn, and the affected parts well soaked with potash lye before the insecticide is applied.

All affected sheep should be isolated; while, further to prevent the spread of the parasite, racks, rubbing-posts, or anything with which the animals have come in contact, should be washed with above solution of corrosive sublimate.

Scarlatina.

Scarlet fever of horses: A febrile disease exhibiting petechiæ on mucous membrane of nose and mouth, and scattered eruption, usually vesicular, of skin and body, with swollen cervical glands and sore-throat, occurring as sequel of debilitating disease—not contagious.

Comfortable box; light digestible laxative food.

Water, given with sodium sulphite and hyposulphite as antiseptics.

Ammonium acetate, spirit of nitrous ether, and camphor in draught, thrice daily, abate fever.

Medicines given in electuary when swallowing difficult.

Inhalation of hot water vapour, medicated with antiseptics or anodynes, relieves breathing.

SCARLATINA—*continued.*

Fomentations, woollen cloths, soaked in hot water or hot oil, relieve sore or swollen throat.

Fomentations with hot water, mixed with sulphurous acid, check external œdema.

Gargles of pot. chlorate, borax, or sulphurous acid, lessen discharge and fœtor from mouth and throat.

Inunction daily with vaselin or glycerin and water removes desquamating crusts.

Small doses alcoholic stimulants, acid solutions of quinine or iron salts, help recovery.

Perfect rest, carefully regulated nutritive diet, are needful throughout convalescence.

SCROFULA. See TUBERCULOSIS.

SEEDY TOE.

A perverted secretion of horn at the lower margin of the os pedis of the horse, by which the crust becomes detached from the horny laminæ. It also occurs at the quarters; is frequently due to laminitis, and is met with in sheep (Professor Williams).

All diseased horn must be removed.

Healthier growth encouraged by moisture, and blisters to coronet.

Pressure relieved by use of bar shoe; clips interdicted; weight thrown on sole.

SEPTICÆMIA.

Septic poisoning; Sapræmia: A febrile condition depending upon the circulation in the blood of the products of putrefaction. The several varieties, depending upon xymines, ptomaines, or specific pathogenic organisms, have not yet been differentiated. It differs from pyæmia in not producing secondary suppuration and abscesses. It occurs in all animals; wounds of the feet and joints sometimes produce it in horses; parturient septicæmia and septic mammitis attack cows and ewes.

Any wound or other source of infection must, if possible, be fomented, cleansed, and rendered aseptic.

Antiseptics and antipyretics internally—sulphites, hyposulphites, sulpho-carbolates, quinine.

Generous dietary, milk, eggs, oatmeal gruel, beef-tea.

Alcoholic stimulants, acids and bitters, improve the faulty appetite.

General hygiene demands careful attention.

To prevent infection of healthy subjects, septicæmia patients should be isolated, their excreta promptly buried, clothes and utensils used by them disinfected.

SHIVERING.

Immobilité; Jinkback: A condition of imperfect motor power of the back and loins of the horse, usually manifested when quickly turned or backed, and depending apparently upon some morbid state of the spinal cord.

Treatment is of little avail; the animal may do moderate slow work without weight on his back.

SHOULDER-SLIP.

Strain of muscles of horse's shoulder.

Foment; remove shoes; rest; purgative.

Blister when tenderness and swelling removed.

SIDEBONE.

Ossification of lateral cartilages of horse's foot.

Bar shoe; cold applications.

Rest; blisters; firing.

Neurotomy usually effectually removes lameness.

SORE THROAT.

Pharyngeal catarrh. Congestion and inflammation of the mucous lining of the fauces and pharynx; common in all animals, notably in horses.

Steam the head with water vapour, which may be plain, or medicated with antiseptics or anodynes.

Gargles of sulphurous acid, borax, and glycerin, or camphor and belladonna extract, relieve congestion and tenderness.

Belladonna also relieves spasms of pharyngeal muscles.

Glycerin of tannin or ferric chloride when throat relaxed.

Liquor chlori or tinctura iodi in diphtheritic or malignant cases.

Heat and moisture applied as fomentation or spongiopiline.

In-rubbing of soap or ammonia liniments.

Mash diet and absolute rest until tenderness of throat has disappeared.

Pharyngeal abscesses occur as sequels of sore throat, are matured by steaming and external fomentation, and may sometimes require to be opened by a guarded knife.

SPAVIN, BONE.

An exostosis on the inner and lower part of the horse's hock, arising from inflammation of the cuneiform and metatarsal bones, terminating generally in anchylosis of one or more of the gliding joints of the hock (Professor Williams).

Rest; cathartic and fomentation where there is much lameness.

In young horses, hasten the inevitable anchylosis by a blister, firing, seton, or periosteotomy.

In old horses the ostitis sometimes partakes of the character of fragilitas ossium, and is incurable.

SPLINT.

An exostosis usually on the inner aspect of the metacarpal or metatarsal bones.

In slighter cases stop fast work, give half dose physic, foment, and subsequently blister.

In more acute cases adopt subcutaneous periosteotomy.

A seton may subsequently be passed over the deposit.

Pyro-puncture preferable to ordinary firing, as it does not blemish.

Mercuric iodide ointment usually reduces deposit.

SPEEDY-CUT.

A bruise on the inner aspect of the horse's limb, in the region of the knee, caused by the opposite foot.

Fomentations; open any abscess: antiseptic dressing.

Prevent by reducing inner crust of offending foot, using nicely fitting three-quarter shoes, and removing shoes every three weeks.

A boot is sometimes worn on the leg liable to cutting.

Avoid over pacing such horses.

SPRAINS OF MUSCLES, TENDONS, AND LIGAMENTS.

The fibres are severely stretched, and in serious cases some of them are torn.

Rest, foment, give cathartic.

Slings useful in bad cases in horses.

When tenderness and pain are abated apply counter-irritants, cantharides, or mercuric iodide ointments, firing iron, seton.

STOMATITIS.

Inflammation of mouth, chiefly occurring in young animals—(*a*) catarrhal; (*b*) vesicular; (*c*) pustular.

Careful feeding, laxatives, salines, remove the gastric derangement with which many cases are associated.

In sucking foals and calves, besides local treatment, see that mother's milk is sound and that she is properly fed.

Prescribe pot. chlorate or borax and glycerin solution.

Ulcerous spots dressed with glycerin of tannin or painted with silver nitrate, 10 grs. to ounce water.

A contagious pustular form amongst horses, occurring in the Berlin clinique, is described by Professor Williams.

STRANGLES.

Febra pyogenica: A contagious eruptive fever, peculiar to horses, caused by a strepto-coccus, which settles on the Schniederian membrane, producing catarrhal symptoms. In normal cases abscesses develop in the connective tissue in the space between the branches of the lower jaw, and involve adjacent glands, while the infective pyogenic organisms are liable to be carried to and inflame other glands in the shoulder, groin, or internal organs. The disease occurs chiefly in young animals and seldom more than once in a lifetime.

Good nursing; perfect sanitary surroundings.

Steam head where catarrhal symptoms troublesome.

Fomentations or poultices to the throat hasten tardy formation of abscess.

Sodium sulphite and pot. chlorate dissolved in drinking water as antiseptics and antipyretics.

Horse at grass should have shelter at night unless weather warm and case slight.

When abscess tardy in development apply soap or cantharidis liniment.

Supply mash, gruel, grass, sliced roots, malt, steamed oats, or whatever soft digestible food patient will eat.

Milk, eggs, beef-tea, with ale or wine if animal weak.

Sweet spirit of nitre and quinine if pyæmia is produced.

Abscess should be fully matured before it is opened; indeed, many practitioners prefer that it should be allowed to burst.

While discharging, the parts must be kept clean, and dressed daily with carbolic oil.

Tracheotomy performed when dyspnœa is not relieved by steaming and fomentations; its timely performance lessens chances of roaring and often saves life.

Isolate infected subjects and disinfect premises.

STRINGHALT.

A spasmodic movement of the muscles of the limbs of the horse usually affecting one or both hind limbs, but not marked by any definite pathological lesions.

Incurable; becomes worse with hard work and advancing years.

Relieve any spavin or other condition which may aggravate reflexly.

Temporary benefit results from a laxative, a course of bromides, and moderation of work.

Stretching and section of the tibial nerves are of no avail.

STURDY. See WORMS. Hydatid in brain.

SURFEIT. Nettle Rash. See URTICARIA.

SWINE PLAGUE. See ANTHRAX.

SYNOVITIS.

Inflammation of the synovial membrane from strain, puncture, localisation of the rheumatic or tuberculous virus. See also ARTHRITIS.

SYNOVITIS—*continued.*

Heat and moisture persisted with for some hours, applied in fomentation or swathing the joints with cloths rung out of hot water; parts afterwards rubbed with soap liniment and laudanum.

Dose of physic relieves pain and fever.

Aconite useful internally and locally.

Slings needed where inflammation affects hock or other large joint of hind limb of horse.

Mercury oleate a useful absorbent, especially in rheumatic and tubercular cases.

Blister must be applied if symptoms not relieved in three days.

Firing in chronic cases.

Rheumatoid and tuberculous synovitis are specially intractable.

TABES MESENTERICA. See TUBERCULOSIS.

TAPEWORM. Tænia. See WORMS.

TEATS, OBSTRUCTED.

The teats of cows and ewes are obstructed by curdled milk, lacteal calculi, tumours attached to mucous membrane, or inflammatory thickening.

Where not removable by careful manipulation, concretions may be displaced or broken up by bougie or teat syphon.

Tumours within the teat if not reducible by iodine dressings should be excised.

Warts on the teats removed by knife or ligature.

Inflammation treated by fomentations, and poultices of spent hops.

Stricture, usually a sequel of inflammation, is relieved by passing probes or syphons.

TENDONS or LIGAMENTS RUPTURED.

Occurs chiefly in horses. See also SPRAINS.

Fomentations allay inflammation.

Treat as for fractured bones; keep parts perfectly quiescent.

Splints; starch bandages; slings.

When inflammation moderated stimulate externally.

TETANUS.

Lock-jaw. Involuntary tonic muscular spasms, probably depending upon a microbe. Occurs in horses and sheep, in the latter usually from exposure to cold.

Place horse in darkened box where he will not be disturbed; enjoin perfect quiet.

Place him loosely in slings.

Dose of aloes, action of which is encouraged by mashes, gruel, treacle, and salines in drinking water, which should be within reach.

Even when jaws are closed patient will suck up sloppy food, which should be rendered as nutritive as possible and offered frequently.

Any wound should be fomented or poulticed, any cause of irritation removed, and anodynes applied.

Powdered opium and cannabis indica extract 30 grs. each softened by admixture of amm. acetate solution placed thrice daily amongst the molar teeth.

Bromides and chloral hydrate afford temporary, sometimes permanent relief, especially when excitement considerable.

THICK WIND IN HORSES.

Depends upon thickening of the mucous lining of the bronchial tubes, or imperfect power in emptying the air-cells.

Seldom curable.

Relieve by giving good, rather concentrated, food damped.

THICK WIND IN HORSES—*continued.*
Allow water in moderate quantity frequently.
Maintain bowels in regular state by occasional salines.
Professor Dick's cough balls.

THOROUGH PIN OF THE HOCK.
A bursal enlargement on the inferior lateral aspect of the thigh and upper and posterior part of the horse's hock, arising from disease of the tendon of the flexor pedis perforans muscle, which is enclosed in a synovial sheath upon the inner side of the os calcis, or from dropsy of the sheath without disease of the tendon (Professor Williams).
Rest; a high-heeled shoe; flannel bandages.
Equable pressure from a spring truss.
Where the swelling is not thus reduced, apply a smart blister.
Other treatment failing, the distended bursa may be opened at its most dependent point.
Thorough pin of the knee consists in distension of the bursa containing the perforatis and perforans tendons at the back and a little above the knee-joint.
Treated similarly to thorough pin of the hock.

THROMBUS.
Extravasation of blood in areolar tissue, usually from blood-letting.
Refrigerant applications or fomentations relieve tension and pain.
Blisters encourage absorption.
Scarify where swelling causes inconvenience.

THRUSH IN MOUTH. See APHTHA.

THRUSH IN HORSE'S FROG.
A morbid condition of the secreting surfaces of the fibro-fatty frog, producing fœtid discharge.
Scrupulous cleanliness; a leather sole is sometimes placed within the shoe while animal in the stable.
Calomel dusted over diseased surfaces.
Dressings of tar or wood-tar oil.
Dose of physic, especially when associated with constitutional causes.
Regulate feeding, exercise, or work.
Shoe with tips if feet strong, and animal works chiefly on land.

TICKS.
Acarida Magna—infest the skins of all domestic animals.
Destroyed by dressing with equal parts oil of turpentine and linseed oil.
Where a few only have got lodgment, they may be snipped off with a pair of scissors.
Melophagus ovis or ked—infests the skin of sheep.
Bath of arsenic, potashes, soft soap and water.
Dressing with wood, coal-tar, or petroleum oils.

TINEA TONSURANS. See RINGWORM.

TOOTHACHE.
Usually results from caries attacking chiefly the molar teeth.
Extract diseased tooth with forceps, or in horse by opening alveoli, punching, and using forceps.
Freely moisten gum with tannin dissolved in alcohol and ether, or with morphine solution.
Warmth, or light dressing of mustard externally.

TREAD.
A wound on the horse's coronet, usually caused by the opposite foot. See also BRUISE.
Poultice; foment; antiseptic dressings; cathartic.
Heels of shoes well rounded off.

TUBERCULOSIS.

Scrofula: A specific disease resulting from the introduction into the body of the tubercle bacillus. This microbe develops irritation and inflammation, either directly or by formation of poisonous alkaloids produced by its action on the tissues. Nodular growths appear, consisting of one or more of three descriptions of cells—lymphoid, epitheliod, and giant—exhibit a tendency to necrosis, followed by caseation, occasionally by fibroid degeneration. The disease may be localised in various organs and tissues, occurs in all animals, and is communicable from one species of animal to another. Cattle, poultry, and hogs are more subject to its several forms than horses, dogs, or sheep.

Generous, rather oleaginous, diet.

Maintain healthy function of bowels and other excreting organs.

Avoid, for breeding purposes, all animals of tuberculous taint.

Milk and flesh of tuberculous subjects liable to transmit the disease to men and animals.

(a) *Phthisis pulmonalis.*

Pulmonary consumption; Tuberculosis of lungs. Common in cattle, sheep, and swine.

Careful, generous dietary; good sanitary surroundings.

Tonics; acids; alcoholic stimulants; antiseptic inhalations.

Arsenic sometimes arrests early stage of consolidation.

Iodine liniments and rubefacients, externally, also check consolidation and cough.

Chloral and morphine relieve cough, which see.

(b) *Tabes mesenterica.*

Tuberculous disease of the mesenteric glands.

Digestible nourishing diet.

Treat on same principle as for phthisis pulmonalis.

Feed off without delay cattle or sheep of tuberculous taint.

(c) *Tuberculous abscess of throat or other glands.*

King's evil.

Foment if hot and painful; dress with iodine liniment.

If pus forms, evacuate and treat antiseptically.

Liberal dietary; tonics; calcium chloride.

(d) *Tubercular arthritis.*

Chiefly affects young animals.

Good feeding and sanitation; comfortable, warm quarters.

Apply flannels wrung out of hot water or hot oil, followed by mercury oleate and laudanum.

Active counter-irritation is injurious.

TYMPANITIS. See HOVEN.

UDDER, INFLAMMATION OF. See MAMMITIS.

ULCER.

A breach of continuity in a part, leaving an indented suppurating wound. Ulcers are classified as healthy, weak, indolent, inflamed, phagedenic, and specific.

(a) *Healthy ulcers* discharge laudable pus, and if kept clean heal quickly by granulation.

(b) *Weak ulcers* require mild astringent dressings.

A flannel bandage, where it can be used, affords equable healthy pressure.

Easily digestible, nourishing diet; the patient should have suitable exercise.

(c) *Indolent ulcers* treated by a blister, followed by mild stimulants, such as mercurous oxide wash, mercuric iodide solution.

A purgative generally useful.

ULCER—*continued.*

(*d*) *Inflamed ulcers* require removal of any irritant, with poulticing and fomentation.
Purgative and digestible cooling diet.

(*e*) *Phagedenic or gangrenous ulcers* require free scarification.
Removal of any irritant; fomentations; antiseptic poultices.
Occasional painting of sloughing edges with silver nitrate.
Purgatives; salines; antiseptics; tonics internally.

URINARY DEPOSITS. See CALCULI.

URTICARIA.

Surfeit; Nettle Rash: An evanescent skin erythema, with circumscribed, rather itching elevations, which usually appear and disappear with equal rapidity.

Damp the skin repeatedly with an alkaline solution containing $\frac{1}{80}$th part pot. cyanide.

Corrosive sublimate, hydrocyanic acid, and glycerin and water, also allay irritation.

A laxative and attention to diet further cure.

Salines, antiseptics, and tonics serviceable in debilitated subjects.

URETHRITIS.

Inflammation of the urethra.

Copper, zinc, or silver salts injected in dilute solution, 1 part to 60 water.

Oils of copaiba and eucalyptus, as antiseptics and anodynes, internally and locally.

Prevent occlusion by cautious introduction of catheter.

Persistent obstruction from inflammation or gravel in male sometimes requires perineal opening.

UTERUS, INFLAMMATION OF. See METRITIS.

VAGINITIS.

Inflammation of mucous membrane of vagina.

Irrigate with mild astringent solutions.

To astringent add a little laudanum if irritation persistent.

Laxative; cooling diet; keep patient quiet.

VARICOSE VEINS.

Dilatation of veins.

Bandages wetted with cold water.

Any abscesses appearing are to be opened; blisters useful in this stage.

Good food; tonics.

Where enlarged vein liable to injury or blocked with clot, obliterate by acupressure.

VARIOLA EQUINÆ.

Horse-pox: A specific contagions fever, depending upon a microbe affecting the skin and mucous surfaces, and passing through papular, vesicular, and pustular stages. Of rare occurrence.

Salines; antiseptics internally; cooling, laxative diet.

Borax or sulphurous acid solutions abate irritation of aphthæ in mouth and throat.

Lead subacetate solution, with glycerin and water, relieve skin eruption.

Prevent spread by isolation of patients and disinfection.

VARIOLA VACCINÆ.

Cow-pox: A contagious eruptive fever, depending upon a micrococcus, which, after an incubation period of six to nine days, produces on the udder and teats an eruption, which passes through the stages of

WORMS—*continued.*

TREMATODA. FLUKEWORMS.

Distoma hepaticum, causing liver rot in sheep, rabbits, and hares, and occasionally cattle.

Furnish affected sheep with concentrated dry food.

Common salt and ferrous sulphate dissolved in water, given daily, mixed with bran or crushed grain.

To prevent affected sheep losing condition and disseminating the disease slaughter as soon as possible.

Keep sound sheep from pastures on which rotten sheep or rotten hares or rabbits have grazed, from low-lying wet land or from grazings with stagnant pools—situations which nurture the fluke, ova, and embryo forms, and the fresh-water snail (*Limnæus truncatulus*) which constitutes the intermediary host.

Several species of distomata occur in the liver and other organs of sheep and other animals.

CESTODA. TÆNIA. TAPEWORMS.

Most animals are liable to be infested with one or more species.

Horses, in which three species are occasionally found, eating tolerably clean vegetable food, are not so subject to tapeworm as the omniverous dog or pig. The dog from different sources swallows the larval forms of six distinct species.

Horses treated with oil of turpentine and male shield fern extract, a dose of physic, and subsequently with copper sulphate.

The several tapeworms infesting the dog are destroyed by areca-nut 30 to 60 grains, male shield fern extract 10 to 15 minims, given with syrup of buckthorn, oil, or mucilage.

Dogs protected from tapeworm by preventing their eating the viscera of sheep, hogs, or rabbits, or the brains of sheep in which tapeworm larvæ occur.

The cysticercus or measles of pork, beef, or mutton are tænia larvæ, each producing their particular tapeworm.

The cœnurus cerebralis, the hydatid causing sturdy in sheep, is the encysted larva of tænia cœnurus, and attains its mature form in the intestines of the dog, which in turn disseminates the ova which undergoes one of its developments in the brain of the sheep.

WOUNDS.

A wound is defined as a breach of continuity of living tissues, caused by a mechanical agency. They are classified as Incised, Punctured, Lacerated, Contused, Gunshot, and Poisoned.

Foreign bodies must be removed.

Hæmorrhage arrested by—(*a*) Ligaturing any considerable vessel which has been cut or opened; (*b*) Application of a tourniquet; (*c*) Allowing water to trickle over the oozing surfaces; (*d*) Pressure; (*e*) Application of styptics.

The *severed surfaces* of accidental wounds, after removal of foreign bodies and blood clot, should be rendered aseptic by washing with an effectual antiseptic.

(*a*) Carbolic acid 1 part with 20 to 40 of water.
(*b*) Corrosive sublimate 1 part, common salt 7½ parts, water 1000 parts.
(*c*) Zinc chloride 1 part, water 80 to 100 parts.
(*d*) Mercuric iodide and pot. iodide each 1 part, water 1000 parts.
(*e*) Hydronaphthol 1 part, rectified spirit 1 part, water 300 parts.
(*f*) Sodium hydrofluosilicate—a recently-discovered effectual non-poisonous cheap germicide, used in proportion of 1 part to 500 water.

The first three applications, although most effectual antiseptics, combine with albumin, destroy a film of abraded surface, and hence retard healing by first intention.

WOUNDS—*continued.*

Carbolic acid being volatile, the dressings properly saturated with it continue for several days to maintain an aseptic state of wound and discharges.

The mercuric iodide solution is less liable to be absorbed and less poisonous than the mercuric chloride, does not combine with albumin, and does not irritate delicate tissues.

Sulphurous acid or chlorinated soda solutions, although not such powerful germicides, do not irritate or injure the living tissues (Dr G. S. Woodhead, *The Journal of Comparative Pathology*, 1889).

All antiseptic precautions must be observed, not only as regards the wound itself, but the instruments, hands of operator, etc.

Incised wounds are brought together by sutures, pins, or plasters.

Bandages applied maintain the parts in apposition and give support.

Splints and slings sometimes needful.

In large contused or lacerated wounds a dependent opening must be provided by drainage tubes or otherwise.

Superficial wounds heal by first intention when edges are held in apposition by plaster, styptic colloid, or shellac applied in methylated spirit.

Deeply *punctured and contused* wounds are fomented for some hours in order to limit inflammation. Over a sheet of carbolic lint, poultices may be applied ; or over the lint cold water may be allowed to trickle.

Poisoned wounds demand different treatment according to their nature.

By ligature the poison may be prevented entering the circulation.

Excision of the poisoned textures may be desirable, and subsequent cauterisation or irrigation with a germicide.

Wounds properly put up and going on satisfactorily should be disturbed as little as possible, except for cleansing and replacing external dressings ; there need be no hurry in removing sutures.

If a wound becomes inflamed or painful, or the discharges are unhealthy, the dressings must be removed, sutures cut out, any clots or other irritants removed, the surfaces irrigated or syringed with an antiseptic, and over the carbolic lint a poultice if needful applied.

Opium and belladonna used with poultices or antiseptics when there is much pain.

Excessive granulation checked by pressure, astringents, or occasional use of caustic.

A dose of physic, cooling digestible diet, and healthful surroundings are essential to the successful treatment of wounds.

INDEX OF MEDICINES.

THE END.

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